Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLII. No. 18. NEW YORK, SATURDAY, MAY 2, 1903. ISSUED WEEKLY

ELECTRICAL REVIEW

13 to 21 Park Row NEW YORK

BY THE

ELECTRICAL REVIEW PUBLISHING COMPANY

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TELEPHONE CALL (private branch exchange connecting all departments) — "21 Cortlandt."

REGISTERED CABLE ADDRESS — "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	10
Copies supplied for only one year back, each	25

TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

FAN MOTORS.

With the approach of summer the fan motor again takes an important place. From being a luxury, the fan has now become a necessity in all well-appointed offices. As each spring comes around, new types are brought out which have some advantages over those of the preceding year. The most noticeable recent improvements are toward securing a better distribution of air, and we have now several types which distribute the breeze throughout a large arc. In one of these the current of air is deflected by oscillating vanes. In another, the motor itself oscillates from side to side, and in a third type it is suspended from a swivel and revolves in a circle. All of these types are good, as they produce a thorough stirring up of the air in the room, and avoid the draught which sometimes was an undesirable feature in the old type.

TENDENCIES IN CENTRAL STATION DESIGN.

When the first alternating-current electric light plants were built, there was one dynamo installed to which all circuits were connected. Sometimes a second machine was installed to take the place of the first during periods of light load or at night, but during operation all circuits were connected to one machine.

Increase in Size of Stations.

Later as the business increased and the one machine was found too small to handle it, others were installed. These were operated independently, each supplying its own circuits, and the switchboard arrangements, though simple as compared with switchboards as built today, were nevertheless complicated for the work which was to be performed, it being necessary to provide for many different combinations of generators and circuits to prevent shutdowns and to allow for economical operation. In those days, dynamos were driven by means of fast belts, and parallel operation was unsatisfactory.

Increase in Size of Units.

Still further development brought about the necessity for increasing the size of the generating units, and as these could be direct-connected to the engine, economical conditions were more favorable for parallel operation, and this became the order of the day. This method of operation, however, brought its problems. More or less trouble was encountered in preventing current surging, due to irregularity in the driving power, but these have been satisfactorily solved.

The Switchboard.

The switchboard has grown from a simple frame of wood or slate, until to-day it occupies a considerable portion of the generating station and in some cases represents a part of the building as distinct as the boiler house or engine room. From small knife switches operated by hand, we have progressed to large mechanisms, each enclosed in a fireproof compartment and operated by a motor or some other apparatus. The switchboard attendant no longer throws the switch; he merely controls the mechanism which operates the switch. The switchboard itself, though now a board no longer, occupies two or more floors with galleries, with signaling devices and automatic appliances, which to a great extent take the place of the cool head and quick hand of the old-time switchboard attendant.

Individual Operation of Large Units.

Now, another tendency in design is being felt. The disadvantages of tying all machinery together and involving all in a common breakdown, are becoming serious. Economical operation requires that the generating machinery be concentrated as far as possible, while reliability of operation is better secured by separate generating stations. The two demands are resulting in individual operation of units at a large station, and this system promises excellent results. Not only may each generating set have its own feeders, but each may have its own boiler plant, the separate boiler plants being isolated so that an accident to one will not affect the others.

Reliability Expensive.

All of this progress toward reliability involves greater expenditure for installation, and although it might seem to the business man a better method to incur a greater risk at less expense, the engineer feels it incumbent upon him to make the operation of the plant as absolutely sure as is possible. At first thought, it might seem that an insurance method, as has been suggested, would be feasible, yet it could not guarantee the operating company against loss of confidence, which is one of its best assets.

The Steam Turbine.

The effect of the steam turbine on power station design is as yet uncertain.

That the turbine will be used largely, can not be doubted, for already enormous orders have been booked for this prime mover. What little experience we have had tends toward inspiring a confident feeling; still, it will be many years before the reciprocating engine is entirely displaced.

STEAM TURBINE TYPES.

The steam turbine is justly attracting no little attention at this time, for this prime mover has in recent years inspired such confidence on the part of practical engineers that orders have been entered by the various manufacturers which, including units already delivered and to be delivered in the future, will aggregate a figure which represents a considerable proportion of the reciprocating engines to-day in use in this country.

Differences Between Turbine and Reciprocating Engines.

The development of the steam turbine is along lines in marked contrast to those of the reciprocating engine. It operates at a high speed. Indeed, one of the difficulties in the design of this engine has been to obtain a fairly low speed, suitable for direct-connection to generators. As for itself, the turbine is remarkable for the absence of accessories and complex parts. In principle, it may be compared with the impulse water-wheel. Steam is allowed to pass through a suitably arranged chamber, and in so doing acquires velocity which is imparted to suitably arranged vanes. There is no moving piston, which, as in the reciprocating engine, takes in steam bit by bit and expands it. The flow of steam is continuous, except as it may be interrupted to allow for governing.

Three Types of Turbine.

There are three types of steam turbine which have been brought to a practical stage of development. Although all three in a sense use steam in the same way—that is, by allowing it to impart the velocity acquired during expansion to a suitable revolving mechanism—the means of doing this is different. In the De Laval turbine, steam is expanded from the boiler pressure to the atmospheric pressure—or, indeed, to that in the condenser—in a conically shaped nozzle. The available work represented by the expansive force of the steam is then converted into kinetic energy, which, in turn, is imparted to the vanes upon which the jet of steam impinges. The whole expansion takes place in the nozzle, and hence the change of temperature is confined to that part. The revolving portion does not come in contact with the hot, high-pressure steam. There is no need for packing of any sort, and there is no loss due to the friction of rubbing parts. The Parsons turbine admits steam at boiler pressure into a chamber. Expansion begins here, forcing the steam through sets of alternately fixed and movable blades, the steam issuing at the far end of the chamber either slightly above the atmospheric pressure, or that of the condenser. In the Curtis turbine steam is first admitted to a set of nozzles, where it partially expands, acquiring velocity. It then impinges upon a set of movable discs, imparting to them some of its kinetic energy. Rebounding from these vanes, it strikes a second set which is fixed. This set acts as a guide, deflecting the steam against a second set of movable vanes. This process is carried on through several sets of vanes until the steam has given up much of its kinetic energy. It then meets with a second set of nozzles, expands to a still lower pressure and temperature, and passes through a second set of fixed and movable vanes. This process is carried on through as many sets of nozzles and vanes as may seem desirable, the steam issuing from the final set at atmospheric or condenser pressure.

Advantageous Features of the Turbine.

The features which distinguish the steam turbine from the reciprocating engine, and which promise to play so large a part in station design in future, are these: The steam is expanded continuously, and not bit by bit; it flows through the engine continuously in the same direction, and there is, therefore, no reciprocating change of temperature, as is true with the reciprocating engine; the absence of rubbing friction in the parts exposed to the high temperature of the steam does away with the necessity of lubrication. This permits the use of superheated steam—that is, steam heated to a temperature higher than that at which evaporation takes place in the boiler. These high temperatures make difficult satisfactory lubricating of a reciprocating engine piston. Further, the higher the initial temperature of the steam the larger percentage of its heat energy can be converted into work. Since the steam turbine has no pistons, and consists of nothing but a moving disc or series of discs and fixed vanes or nozzles for guiding the steam jets, it is far simpler than the elaborate and complex reciprocating engines which have resulted from the development of this type of prime mover. The driving force of the turbine may be continuous and not pulsating, as with the reciprocating engine. This is an important advantage for operating electrical machinery, and high speeds are easily obtained. Indeed, the difficulty is rather to secure speeds low enough for direct-connection to generators.

Large Output from Small Machines.

Since steam may be passed through the turbine continuously, for a given output the size of the machine may be much smaller than that of the reciprocating engine. It is, perhaps, not unfair to compare the reciprocating engine to the old method of drawing water by means of a bucket and a sweep, which could raise but one bucketful at a time, while the steam turbine may be likened to a chain pump, which gives practically continuous delivery.

RADIUM EMISSION.

The fact discovered by the Curies, that radium maintains itself at a temperature of 1.5 degrees centigrade above that of its surroundings, has attracted no little attention in scientific circles.

Heat May Be Due to Discharge of Atoms.

It has not yet been shown whether the heat which must thus be radiated is given off directly as heat from the radio-active material, or is a secondary effect caused by some higher evolution of energy. In this connection, an expression from Sir Oliver Lodge is of much interest. Sir Oliver points out that radium emits massive, positively charged particles, which are

probably atoms, with a velocity comparable to one-tenth the speed of light. Most of these particles are stopped by a small thickness of air, with the evolution of heat; and if the conditions were such that this heat accumulated, on the average, for one minute before escaping, and assuming the heat capacity of the source and the surrounding air to be equal to that of one milligramme of water, a difference in temperature of 1.5 degrees centigrade would be set up.

What Causes the Discharge of Atoms.

This is a very plausible suggestion to explain the difference in temperature, but as yet no explanation has been offered to account for the emission of these heavy particles. The more radium is studied, the more puzzling it becomes, and this latest discovery throws little or no light upon this extraordinary substance.

AUTOMOBILE REGULATIONS.

The Legislature of the State of New York passed recently a law for regulating the running of automobiles which has called forth no little dissatisfaction from the users of automobiles.

Absurd Regulations Harmful.

There has no doubt been a great deal of reckless driving on the part of automobilists, and this should be, and no doubt is, frowned upon by those who have the interests of this sport at heart, and they should be willing to cooperate with the state authorities in preventing abuses. But the automobilist has certain rights which should be recognized, and it will only injure this new industry if regulations entirely too severe are imposed upon it.

Sensible Regulations Needed.

The automobile is here, and it is here to stay. At the present time the novelty has not worn off, and conditions are such that the number of persons who can afford an automobile is somewhat limited. These, however, are doing a good work in the testing and in assisting developing of the various types of machines. If the speed is to be so restricted that the automobilist will not be able to pass a team when on the road, automobiling will lose much of its charm, and the industry will thereby suffer severely. Let sensible regulations be drawn up and approved, and then let them be properly enforced. In this way the industry will be helped and not harmed.

COHERER ACTION UNDER THE MICROSCOPE.

BY G. T. HANCHETT.

As is generally known, the Branly coherer consists of a tube containing a small pinch of metal filings between two electrodes. In their normal condition the resistance of the filings is quite high and a telegraph sounder connected in series with a battery and coherer will not operate. If, however, the filings be traversed by high-frequency current of even feeble intensity, the resistance of the filing becomes suddenly reduced and the receiver will operate. A shake of the tube containing the filings restores the coherer to approximately its original resistance and the obvious inference is that the filings contact together more closely, forming a better contact and lower resistance through which the electric current may flow.

That this is actually the case may be observed by means of a simple microscopic experiment. A microscope with a one-inch objective will answer nicely. A slide is prepared with two wires, the wires being attached to the slide with shellac and bound with pieces of glass, or the wire may simply be laid on the slide and an ordinary visiting-card placed underneath the stage clips, thereby holding the wire in place. The wires should be brought within about one-thirty-second of an inch of each other and one should be led off to the ground, while the other may lie freely on the table or be connected to a mast, as the experimenter may desire. An induction coil should be connected, one terminal to ground and the other to another mast, if so desired. As it is usually preferable to have the experiment all in one room, the mast may be upright, insulated pieces of wire. The stage wires should be moderately fine, say No. 32, in order that moving them will not disturb contacts immediately under the objective of the microscope. Having focused the objective, it will be observed on operating the induction coil that a stream of sparks passes from terminal to terminal on the microscope stage and appear quite formidable when viewed through the instrument. A pinch of nickel filings may then be sprinkled between the terminals by means of a point of a knife and their action on operating the coil will be unmistakable. The filings will be seen to rearrange themselves with a mechanical movement and sparks will scintilate among them. After the passage of a few sparks at the coil the sparks in the microscope field and motions of the particles will cease and it will require a considerable tapping of the slide, or preferably disturbance with a sharp point to decohere the filings once more. The cohering action is much more marked if the points are not shunted by a battery and receiving instrument.

This experiment seems to justify the assumption that coherer action involves a mechanical motion of the filings which therefore act in response to some force, and it becomes interesting to speculate what this force may be. There is practically no possibility of its being electromagnetic, for much larger currents than those of the coherer circuit do not appreciably affect the motion of the filings, and, moreover, it may be readily shown by similar experiments that any light powder such as plaster paris, lycopodium or other materials coheres in the same way and even more promptly and vigorously but is much more prompt to decohere; in fact, doing so instantaneously. Of course, these materials do not afford any resistance variation in the metallic circuit as do metal filings.

The reasonable inference seems to be that the force which moves the filings is entirely electrostatic; and, in fact, the tendency of some coherers to decohere themselves is thereby easily explained, for the charged particles, having acquired charges of the same character, will then tend mutually to repel each other, thereby depreciating the electrical contact between them.

From the foregoing, the requirements for a good coherer readily follow. First, particles should be impervious to oxidization. This has been found to be necessary, as demonstrated by the permanent character of the exhausted coherer compared to that of the open type. Second, the particles should be as light as possible in order that they may more quickly and thoroughly respond to the minute forces which tend to rearrange them. Aluminum would be an ideal metal for this purpose were it not for the fact that it rapidly, in fact almost instantly, acquires an oxide coating which though very thin, is sufficient to destroy the efficiency of the coherer. Thirdly, the number of filings in the coherer should be the smallest possible. It is evident that a given amount of electrostatic force impressed on a large number of filings will not rearrange them so as to reduce sensibly their resistance as thoroughly as the same force exerted on a smaller number.

An Electrically Operated Milling Plant in Scotland.

By Frank C. Perkins.

AN electric light and power plant has recently been installed at the works of Messrs. Andrew Lowson, Limited, of Arbroath, Scotland, by the British Schuckert Electrical Company, Limited, of London. This power-house is of particular interest, as the current is transmitted to various mills and factories in different sections of the city, all being owned by the same concern.

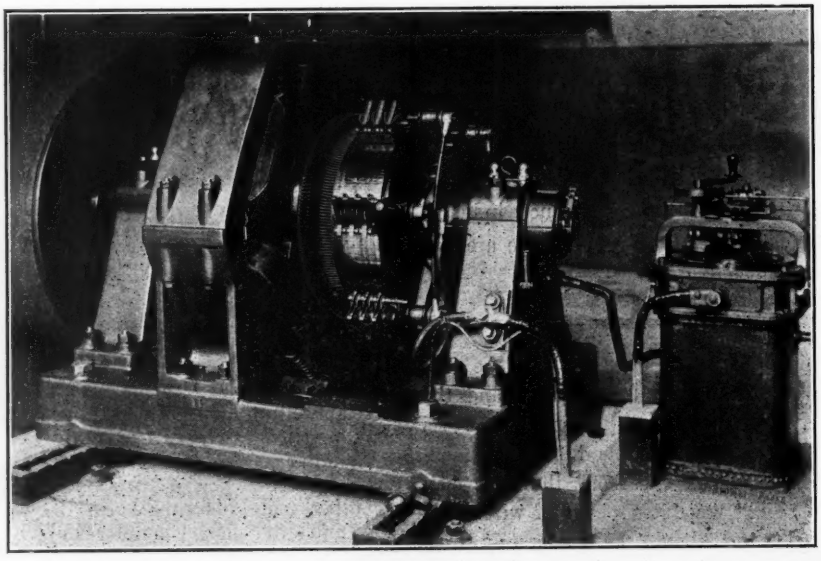


FIG. 1.—150-HORSE-POWER SHUNT MOTOR, 500 VOLTS, AT LOWSON'S MILLS.

The engines were installed by Willans & Robinson, of Rugby, England, and the boilers were built by J. Carmichael & Company, of Dundee. The plant has a total capacity of about 2,000 horse-power, each of the half dozen mills requiring about 300 horse-power. The accompanying illustration, Fig. 3, shows one of the units of 600-kilowatt capacity directly connected to a Willans three-crank, high-speed, compound engine. There are two of these large units, each of which includes a Schuckert twelve-pole, direct-current generator, supplying a continuous current of from 500 to 530 volts pressure.

The power station is 150 feet long and forty feet wide, and there are three boilers in position, while the boiler room has a capacity for double this number. Mechanical stokers are employed, the coal being delivered from the trucks directly into the bunker, and a special apparatus is provided for raising the coal into the hoppers of the stokers. Each of the two banks of boilers will be served by a set of economizers.

In the engine room a small direct-connected engine and generator are to be utilized for supplying power at light load, and for lighting the factories, while the two large sets will be employed for taking care of the heavy load, and general power transmission. Fig. 2 shows the type of 150-horse-power motor utilized at the various mills. One of the switchboards includes two marble panels, upon which are mounted the required cutouts and quick-break switches for the Inch and Baltic mills, while another switchboard includes three marble panels, with switches, cutouts, and measuring instruments for motors No. 1 and No. 2.

The main switchboard in the generator room consists of three marble panels, two of which are generator panels, and are equipped with rheostats, voltmeters, ammeters and cutouts, of the Schuckert type. The feeder panels are equipped with fuses of 1,500-ampere capacity, and the bus-bars and feeders are designed for a load of 3,000 amperes. The feeders were furnished by the British Insulated & Helsby Cable Company, Limited, and are of the single core design, and located in cast-iron pipes about six inches in diameter, passing about a thousand feet along the walls of the mills on iron brackets.

There is a distributing switchboard at Inch No. 2 mill, the two cables being placed in three-inch iron pipes, a total of about 300 feet, on the mill walls, and are then carried under a stream separating the above mills from the Baltic mill, which is about a quarter of a mile from the power station.

The accompanying illustration, Fig. 2, shows the type of dust-proof case which is used to protect the motors in the weaving sheds.

There are two motors of about seventy-five-horse-power and 100-horse-power capacity on the main floor of the John street mill, while one of fifty-horse-power capacity and another of 150-horse-power capacity are located on platforms, as shown in illustration Fig. 1, being supported by brackets and joists of rolled steel built in the walls of the mill. It is necessary that the motors be varied to quite an extent in speed, when used for operating preparing machines, and for flax spinning, and for this reason a variation of ten per cent is obtained by shunt regulators governing the speed of the motors.

At one of the mills two 150-horse-power motors have been employed to replace an engine, and special devices have been designed to make it impossible to cut out the starting resistances too quickly. There are a number of dust-proof wall boxes of the type shown in Fig. 2, em-

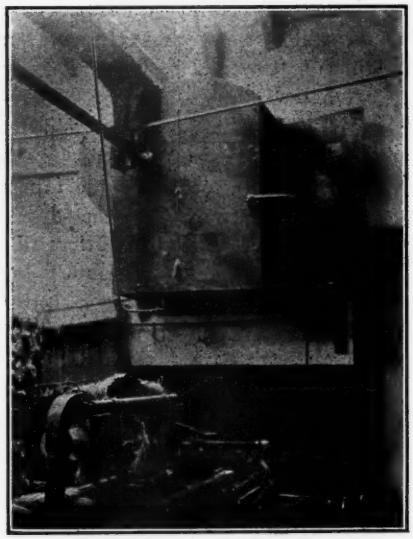


FIG. 2.—DUST-PROOF CASE AROUND 25-HORSE-POWER MOTOR, BALTIC WEAVING MILLS.

ployed in the weaving factory at the Baltic mill, where there is a great amount of dust in the air. These dust-tight boxes are each utilized for enclosing a motor of twenty-horse-power capacity, and pipes are provided, as shown in the illustration, for obtaining the necessary ventilation. The controllers, starting resistances,

switches, fuse boxes and automatic device for cutting in the resistances, should the current fail, are all located in an adjoining room. The speed of the motors is varied about ten per cent from the normal, which is 1,000 revolutions per minute, by means of varying the resistance in the shunt-winding.

The incandescent lights for the Baltic mill are supplied by a motor-generator of about thirty-kilowatt capacity, the motor operating at 500 volts, and the generator supplying a direct current of 110 volts. It is claimed by the owners of this power-transmission plant that there is a great saving obtained by the use of large direct-connected engines and generators located in a single power-house, over the former method of utilizing several smaller engines in the various mills and smaller dynamos located directly where the current is utilized. The fact is now well established that electric motors are more economical, cleanly and safe for the operation of all kinds of machinery in mills and factories. The design of this Scottish electric power-transmission plant is due to R. D. Munro, of Glasgow, Scotland, under whose supervision the power-house and power distribution was installed.

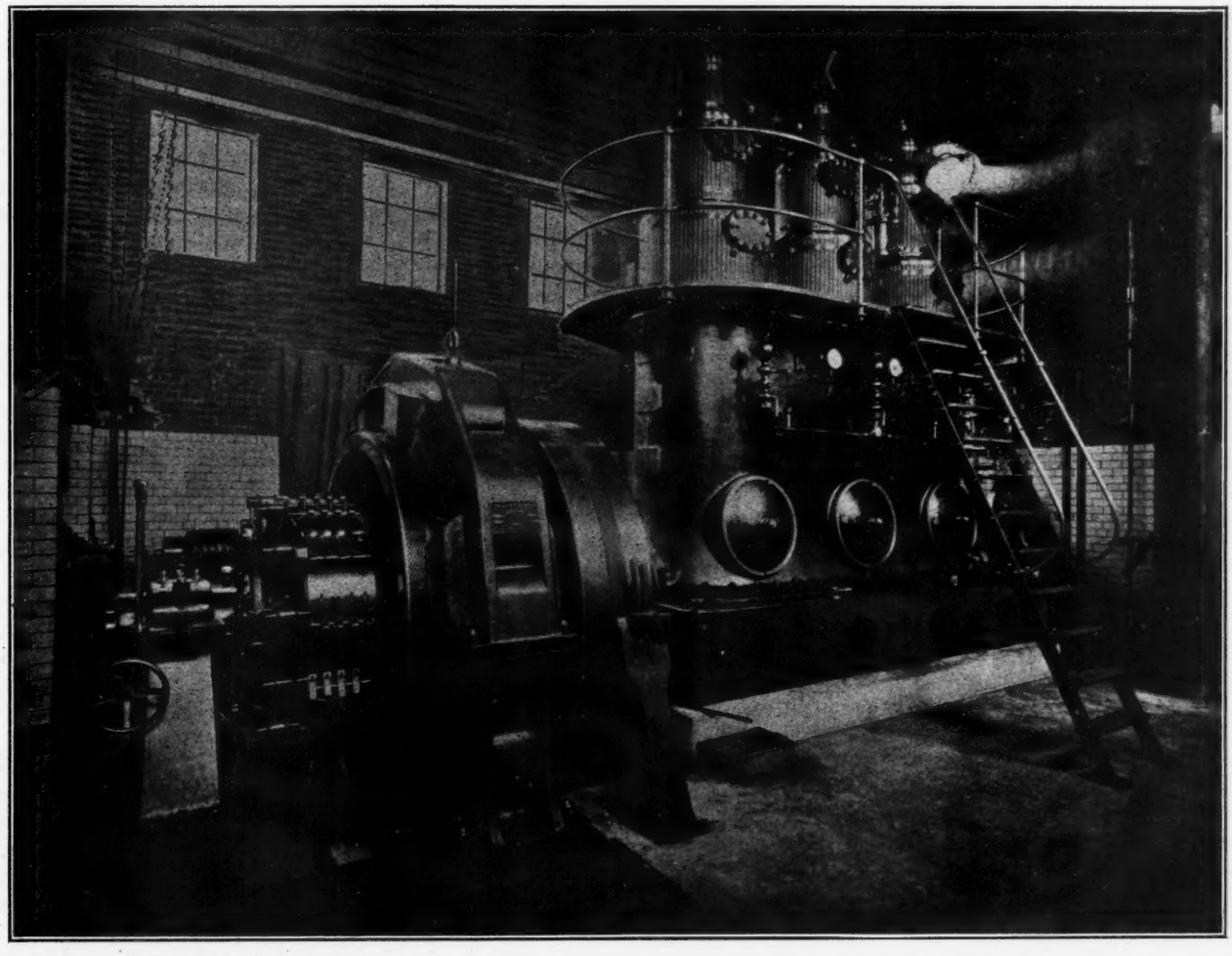


FIG. 3.—ONE OF THE 600-KILOWATT UNITS, IN THE 2,000-HORSE-POWER PLANT, ANDREW LOWSON'S MILLS.

Preliminary Study for a New Standard of Light.

In a recent article in the London *Electrician* Mr. J. A. Petavel gives a study of photometric standards. Three standards of light are needed—the absolute standard; a second standard, carefully compared with the absolute standard, and preserved in a few of the principal laboratories throughout the world, and a commercial standard, the accuracy of which will depend on the requirements. A standard of the first class should be both constant and reproducible, whereas standards of the second and third classes need not be reproducible. The author has recently conducted an experimental investigation of the Voille or platinum standard, which was entirely satisfactory. Although this standard is expensive and complicated, these are not serious objections to an absolute standard. There are a number of so-called primary standards which, while not satisfactory for this use, are quite satisfactory as commercial standards; but there is no reliable secondary standard. While incandescent lamps are most generally used for this purpose, they change gradually. The author has made comparative tests of incandescent platinum, platinum-iridium, and iridium. The intrinsic brilliancy of iridium is about fifteen times as great as that of platinum, and the light is very white in color; but iridium foil can not be maintained indefinitely at high temperatures. In using these metals it is necessary that the temperature be regulated, and there is but one satisfactory method of doing this—that is, by determining the relative intensity of the radiations of two different wave-lengths. The apparatus for carrying out this work is described. Two screens are used—one of water and glass, and the other of black fluorspar; the first being opaque to the long waves, and the latter to the short. Light is allowed to fall on these screens, and thence on two thermopiles which are connected in opposition, and the point is determined where the two radiations are equal. This occurs at a definite temperature. While the incandescent lamp is more convenient, the author thinks there is still a place which can only properly be filled by an apparatus of this type.

Tendencies of Central Station Development.

The One Hundred and Seventy-sixth Meeting of the American Institute of Electrical Engineers, Held at 12 West Thirty-first Street, New York City, Friday, April 24.

THE one hundred and seventy-sixth meeting of the American Institute of Electrical Engineers was held at 12 West Thirty-first street, New York city, Friday, April 24. Secretary Ralph W. Pope announced that 211 associate members had been elected at the meeting of the board of directors, and that the following associate members had been transferred to full membership. Frederick Darlington, of Great Barrington, Mass.; S. E. Johannessen, Pittsburg, Pa.; M. von Recklinghausen, New York city; William Esty, Bethlehem, Pa.; Robert Robertson, Glasgow, Scotland.

An announcement was also made that the secretary had received a check for $1,350 from Mr. C. O. Mailloux as a contribution toward the library fund. Of this amount, $1,000 was to be set aside as a fund, the interest of which is to be used to keep up the files of the journals which the donor had previously given to the Institute.

President Scott introduced Mr. Adolf Franke, technical director of Siemens & Halske, Berlin, and welcomed him on behalf of the Institute. Mr. Franke, in a few words, thanked the Institute for its cordial welcome.

President Scott then introduced the subject of the meeting: "Tendencies of Central Station Development." He referred to the use of tools and co-operation as two of the earliest elements made use of by mankind. The development of these may be traced through all stages but notably during the last century. They have brought about a new order of things and a new condition of civilization. At the time of Dr. Johnson, the mind of one man was presumed to encompass the whole of human knowledge. But now conditions are different. Society is a vast unit, all the elements of which are interdependent. No industry shows such complete development of the two elements, tools and co-operation, as does the central station. Electricity has not only replaced many other agents, but has brought about development along new lines, and the agent for carrying on all these different operations is supplied from a common central station. There each element depends on all the others and all demand the greatest ability of engineers. Illustrations are not wanting to show how thorough and complete the development had been in this work. The New York Edison company was mentioned, which in ten years has not been interrupted, and not without current on some of its lines since it started operating. This system has grown so that on March 31, of this year, the output of power was equivalent to 2,391,431 sixteen-candle-power incandescent lamps. Progress in this development has been rapid, but it is now going on at an accelerating rate.

Mr. H. A. Lardner, engineer with J. G. White & Company, then read a paper entitled "Economical and Safe Limits in the Size of Central Stations." Attention was called to the tendency shown by the design of recent plants to concentrate in one station and to use large units. This tendency was criticised, and the point made that two or three stations would probably give results as economical and there would be less liability to interruption over the whole system. If the territory to be served is large, one station conveniently located for coal and water has a decided advantage owing to economy in first cost, labor and lower cost of fuel and water. In such cases the risk of interruption to service is put up with because it is the best kind of service that such community can support, but until the class of territory approaches that of the largest cities, the question of lower first cost and economy of operation must rule. The advantages of large stations in large cities were then discussed. Low-voltage system of distribution is ruled out, as there are few cities where a sufficiently concentrated load can be found for a very large station without exceeding the limit of zone of economical distribution. It had therefore been necessary to adopt alternating-current transmission to substations, and the existence of these substations provides a certain amount of reserve which can be called upon, and the danger of concentrating all of the generating apparatus in one station is in a measure avoided. The advantages of higher distributing voltage were referred to, it being thought that a more insistent demand for a 240-volt lamp would be met by the lamp manufacturers. By the use of the three-wire system and 240-volt lamps, the advantages of 500-volt distribution can be obtained, and it is an open question whether with this system the stations can be made large enough to be built for a fairly low first cost and operated at practically a minimum expense. The alternating-current system of distribution at 2,200 volts has the ability to serve an extended territory. This makes the question of one large station not so important, as the load can be divided between several stations and trunk cables will enable them to help out each other. The size of unit for the most economical operation and floor space was then discussed, the performances of various sizes being quoted to show that moderate sized engines give results comparable with those secured by the use of the extremely large units The steam turbine was then referred to and it was thought that by its use the smaller stations could be operated as economically as the very large ones. The advantages of one large station, then, are the location of the station on the most suitable site, the reduction of floor space by the use of large units and economy of fuel and labor, saving in first cost effected by the installation with large units. Economy of operation is secured by serving many sections having different load characteristics. On the other hand the chosen locality is generally much further from the load than when it is divided among the several plants. The importance of economizing floor space will be reduced by the use of the steam turbine, and the cost for fuel, labor and supervision will be less. Smaller boiler houses will be cheaper, due to saving in coal-handling apparatus. However, the principal disadvantage of one large station is the danger to the whole system, for the disabling of the station leaves the company without any source of power. Shutdowns have occurred in large stations, and are likely to occur again. Greater refinement than is justifiable commercially was not advocated, but the point was made that smaller stations need not lack many of the advantages of the large ones, and that with a number of them in place of one large plant, the necessity for excessive refinement ceases to exist.

Mr. Philip Torchio, engineer with the New York Edison Company, then read a paper entitled "Safety Devices in Central Stations and Substations." This was followed by a paper read by Mr. Peter Junkersfeld, engineer with the Chicago Edison Company, on "Multiple

versus Independent Operation of Units and Central Stations." These papers will be printed in full in the ELECTRICAL REVIEW.

A discussion of these papers brought out many points of interest and also showed differences of opinion among the engineers who took part. President Scott said that the papers were of particular value. They were practical, in fact, they amounted to a heart-to-heart talk from operating engineers. The burden of all the papers is notable—"How can protection against emergencies best be secured."

Mr. H. G. Stott, of the Interborough Rapid Transit Company, said that history is now repeating itself. Fifteen years ago a central station started with one generating set and one circuit. As the business expanded, two or three circuits were operated from the one circuit. Then as other units became necessary, the problem of the operating engineer was to distribute the load properly among the several generators which were operated separately. In those days the generators were driven from high-speed engines by means of belts. As slow-speed engines and direct-connected units came into use, engineers began to look to multiple operation. Now the tendency is to go back to high speed, using steam turbines. However, the steam turbine has not as yet justified predictions made in reference to it. Reciprocating engines have shown performances better than those claimed for the steam engine, and Sulzer engine in the Moabite station was quoted which has given an indicated horse-power for 8.9 pounds of steam per hour. The larger units in New York to-day are arc, consuming approximately thirteen pounds of steam per indicated horse-power-hour. Triple expansion would improve this figure by twenty per cent, and the large units of the present Boston Edison Company's station, which are triple expansion, have given one horse-power for 11.5 pounds of steam with ninety-eight degrees of superheat at the throttle. The size of the station is in no way determined by the size of the generating units. It is decided entirely by the boiler question. The boiler room must run parallel to the engine room and this is a limiting feature. Using steam turbines the same conditions will obtain, and the turbines will have to be spaced accordingly. High-tension lines are not dangerous, but in fact are safer than low-tension lines. When a cross occurs on a high-tension circuit, not more than two feet of the line is destroyed, but on low-tension circuits 1,000 feet or more may be destroyed. The storage battery has found its proper place. It is a safeguard and not an economy. Single operation seemed to be a backward step, a confession of weakness in safety devices. The price of coal is going up continually and the engineer must get the most out of it. The cost for coal to-day is over sixty per cent of the actual cost of power and it is most important to do everything possible to economize in the operation of the plant. This can only be done by running the units as near full load as possible, and to do this, it is necessary to operate them in multiple. The separation of high-tension apparatus can be easily carried out, and as actually carried out, there is no difficulty in making a station practically safe in all lines of operation. The speaker had seen an actual short-circuit in a station with four 5,000-kilowatt machines in multiple, and an oil switch took care of it before the attendant could touch the switch and throw it out. With switching apparatus brought to such perfection as this, we should be very careful about reducing the efficiency of operation of plants by going into independent units.

Mr. Herbert A. Wagner, of the Boston Edison Company, described the operation of the Boston system. All the generators and feeders are in parallel and there has been no trouble. Until two years ago, all the distribution was by alternating current. After consolidation of the Edison Illuminating Company with the Boston Electric Light Company, there had been a gradual change from alternating distribution to alternating transmission with direct-current distribution, which system is now used entirely. Motor-generator sets are used in all substations, which probably accounts for the absence of trouble. The induction motors used cost more and operate with a lower power-factor, but with a proper proportion of induction motors and synchronous motors this could be materially improved. In the Boston plant they are using cross-compound McIntosh & Seymour engines. Nothing would be gained by triple-expansion unless superheating is used. Abroad, separate superheaters are employed, carrying the temperature high, and with this method a compound or even a single cylinder engine would give results equally as good.

Mr. F. H. Waldron, superintendent of the power plant at the Yale & Towne Manufacturing Company, Stamford, Ct., gave an interesting description of his experience with the Parson steam turbine, which had been installed in February, 1902. His first impulse was to get as far away from the turbine as possible, and then he became curious to see how it would behave. Now, he had been brought to admire and respect it. It is simple, easy to operate, economical, and there is a lack of multiplicity of parts, and it requires little floor space. After being installed there is little or nothing to do to it, except fill the oil cups and lubricate the generator commutator occasionally. However, a high vacuum must be maintained and the auxiliaries must be driven by an independent steam engine, and must be taken care of. The turbine installed in their factory is a 400-kilowatt, two-phase machine, and except for the one accident last fall, which was due to a defect in the field casting and which accident caused no damage, has required no repairs. It is operated at 150 pounds steam pressure with ten degrees of superheat and twenty-seven inches vacuum, and it gives one kilowatt-hour for 22.5 pounds of steam. The continuous or commercial efficiency is as good one day as another. The engineer can not get at it to adjust parts, and this is a frequent cause of trouble with reciprocating engines. In their particular case, they were able to install three times the power as a steam turbine unit as would have been possible with a vertical direct-connected unit. This installation cost from ten to fifteen per cent less than a reciprocating engine of the same class; that is to say, one which would be as reliable and give as satisfactory a performance. The cost of the building for the turbine was but sixty-five per cent of what would have been required for a reciprocating engine. One essential in operating turbines was to place the condenser so that contraction and expansion of the turbine can take place. Two supplies of cooling water should be provided and should be inspected from time to time. If the vacuum is lost in operating a reciprocating engine, the machine merely takes more steam, but with a turbine the speed will fall off under the same condition. Hence every precaution must be taken to prevent a loss of vacuum. The exciters and auxiliary machinery should never be driven by motors. Mr. Waldron then took the electrical engineers to task for the power-factor ratings given. As he put it, "The power-factor is a gold brick," and while he would not go so far as to advise the electrical engineers to revise their standards of power-factor, nevertheless an allowance of 0.85 for the power-factor of an inductive load was entirely too high.

Mr. E. H. Sniffin, of the Westinghouse Machine Company, of Pittsburg, Pa., emphasized the point made by Mr. Waldron, that the everyday efficiency of the steam

turbine is a constant quantity and is not variable, as is that of the reciprocating engine, and therefore it is not just to compare the results obtained with the latter machine when adjusted for test, with those obtained from the turbine. In other words, the inherent efficiency of the turbine is better.

Mr. J. W. Lieb, Jr., associate general manager of the New York Edison Company, thought that Mr. Lardner had not considered the important factor of locating stations in large cities. It would be a difficult matter to locate small stations in Manhattan, and the trouble in getting coal to and ashes away from the stations would be serious. The stations, of necessity, cause some annoyance to the neighborhood and as the art progresses and it becomes possible, the objectionable features must be done away with. The requisites are in the direction of extreme refinement for great reliability, and although less reliable service would be satisfactory, the service must be above reproach. Safety can be reduced when the risk involved is commercial. Storage batteries are an absolute necessity as a safety device. Attention was called to unproductive labor which would be multiplied if many small plants were constructed, and the small plants may not be more reliable than the larger.

Mr. W. S. Rugg thought that a multiple unit station—that is, where each generating unit has its own boiler and auxiliary apparatus—could be operated for the same cost as one large station and give all the advantages of many small stations.

Mr. A. V. Abbott thought there was another side to the question, that of the general manager. The safety appliances are merely a form of insurance. One large plant had recently been put out of service for a time, and in spite of all precautions, such accidents will probably occur from time to time. Would it not be a business proposition for a company to be organized which would ensure both the station and the consumers against interruption? The question might be considered from the business side only. The engineer, to avoid all risks, invests large sums of money, but the business man would rather take the risk than to put in so much money.

In reply, Mr. Junkersfeld said that companies are forced to concentrate, as they can not get many desirable sites. With the multiplicity of plants there is much unproductive labor and machinery. The tendency now is toward sectional operation. This practice has already been begun in New York and the use of steam turbines will tend to increase it. The storage battery is profitable in a lighting station with a short peak of only one hour or an hour and a quarter.

Mr. Lardner said that he had been misunderstood. He did not advocate a multiplicity of plants but a subdivision into two or three plants and not one large one.

Mr. Torchio cited two incidences where the load characteristics were such that the storage battery had proved an economy. In one case, with the New York Edison Company, there is a short heavy peak, so that it is enabled to discharge the battery at its full rate. The second was with the Milan Edison Company, operated by water power. In this case, by charging at periods of light load, the company was enabled to sell 4,000 horse-power per year at $60 and therefore add that much to its income.

Mr. Torchio described two new lightning arresters which are now being made in Italy, and known as the "Gola" arresters. The first of these consists of three metallic cones surrounding the conductor. The vertices point in the same direction and away from the generating station. A ring of zinc or some other non-arcing metal is attached to the base of each cone and then against this a metallic disc is placed. Within each cone is a choking coil, the three coils having different electrical characteristics. Siemens horns are placed close to the zinc discs and connected to the ground. The action of this arrester, it is said, is due to the skin effect of the conductor. An electrical discharge having a high periodicity in meeting these cones would flare out toward the zinc ring rather than follow the main conductor, and at the ring it would jump to earth. The other arrester consisted of three basin-shaped discs of iron, the upper two of which are placed with the convex side upward. The lower is reversed and between it and the central one is a ring of non-magnetic metal. The upper two discs are fitted with spark-gaps discharging to the ground. The main line passes through the centre of these discs and then through a choking coil to the ground. The choking coil is so arranged that a magnetic field is set up between the lower and middle disc which blows out toward the discharge points any arcs which may be formed.

An automatic speed limit device, which has been developed by the New York Edison Company, and which operates upon the well-known tachometer system, was shown. This is used to protect compound-wound rotary converters. When the speed rises above the normal by a certain fixed percentage, it closes a circuit and trips the alternating and direct-current circuit-breakers.

CORROSION OF METALS BY ELECTROLYSIS.[1]

A. A. KNUDSON.

The corrosion of metals by electrolysis may be divided into two parts: (1) Galvanic action between dissimilar metals, causing corrosion, and (2) destructive effects of railway currents upon subterranean metals.

Historically the first currents of electricity ever generated by chemical action were probably among the dissimilar metallic ores deposited in the earth. Such currents have long been known to exist, and probably have existed since the world was made. An instance illustrative of the movements of earth currents happened in the experience of the writer some years ago. In grounding a telephone line at a mine in Nova Scotia, where gold, iron, copper, and other metals were present, an earth current was discovered upon the line, of such strength as to prevent the use of the magnetic signal bell. The "ground" at the mine had to be moved a quarter of a mile before relief from these currents were obtained and the line made to work.

Instances have often been found where dissimilar metals placed close together in the construction of vessels, where sea water is accessible, result in corrosion due to galvanic action; if as usual the metals are iron and copper (or alloys of copper) the iron or steel, which is electropositive, suffers the most. An examination made of a copper-plated ocean tug some years ago, may be cited as an illustration. We found after the boat was placed in dry dock, a number of iron patches bolted over the copper-plating at various places on the hull where repairs had been necessary, and at other places iron bolt heads were found against the copper attached to rods which came through the hull securing or supporting machinery upon the inside; in short, after the vessel had left the control of those who plated her, there seemed to be no one on the boat who understood the effect, if the iron of the hull became exposed. Under such circumstances it was not surprising that corrosion had been active, the bolt heads upon the patches as well as the other places were nearly gone, and wherever the iron of the hull was exposed, evidence of electrolysis was found.

Another case of sea-water corrosion due to placing together dissimilar metals, is the galvanic effect upon the propeller shafts of steamers.

Another phase of this subject came

[1] Abstract of paper read at third general meeting of American Electrochemical Society, New York city.

under our personal notice during an examination in a city for electrolysis of water pipes; our attention was called by the superintendent of waterworks to several water meters which he believed had been ruined by electrolysis caused

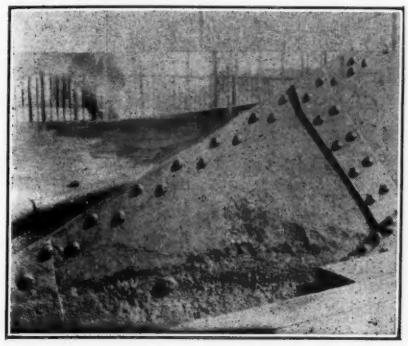


FIG. 1.—SECTION OF BRIDGE GIRDER.

by railway currents. After making careful tests at locations where these meters had been in use, and not finding any signs of railway current, we had one of them taken apart for closer inspection. We found in the interior a brass valve arranged to move over iron slides, the slides being a part of the iron frame of the meter. Suspecting galvanic action, we made an effort to measure the voltage,

FIG. 3.—SIX-INCH PIPE CORRODED BY ELECTROLYSIS.

and selecting a meter that was not so damaged as to entirely prevent its working, we connected the brass valve with an insulated wire leading it out through the discharge, thence to the millivoltmeter; another wire from the iron casing was connected to the opposite pole of the instrument; we then turned on the water from a service tap and allowed the meter to work the same as in practice; the effect was instantly shown upon the millivoltmeter which registered from 0.004 to 0.008 volt.

Before passing to underground mains we will briefly refer to a case discovered last summer which may be of interest as showing the effect of electrolytic action upon the metals of bridges, that are above the surface of the ground, as illustrated in Fig. 1. During an investigation in an eastern city, the superintendent of bridges called our attention to the rapid corrosion of some of the shore spans of one of the bridges, where the heavy planks of the roadway lay nearly against them, there being a space of about one-fourth of an inch between; in this space there had been lodged the sweepings of the bridge, a material composed mostly of animal refuse containing such chemical ingredients as would furnish a convenient electrolyte when wet. At the foot of one of the spans where the worst corrosion was found, a test with a millivoltmeter showed the iron span positive to the surrounding earth with a difference of potential of from 0.05 to 0.06 volt.

In the spring of 1897, the writer discovered, while making an electrical survey in Manhattan in behalf of one of the railway companies, that a portion of the returning railway currents generated at the Kent avenue power station in Brooklyn, E. D., passed over the New York and Brooklyn bridge to underground pipes in Manhattan. Refer to map, Fig. 2. At that time it was supposed that these currents took the shortest and most direct path through these pipes back to Brooklyn, taking the river in the vicinity of Grand street, about opposite the powerhouse which is located on the water front in Brooklyn at Kent and Division avenues.

In October, 1898, while making further measurements on the bridge, practically the same electrical conditions were found, *viz*: currents from Brooklyn flowing over the bridge and down the pillars in Park Row, which support the terminal structure and the elevated railway

FIG. 4.—EIGHT-INCH WATER MAIN.

station, and from them to water and gas pipes in the street.

In the early part of the following year (1899) Mr. Charles R. Barnes, electrical expert for the New York State Railway Commissioners, made at their direction an extended survey through the Borough of Manhattan, and found the electrical conditions at the bridge and other points in the city practically the same as we found them in 1897 and 1898.

In the month of May, 1902, in the interest of parties engaged in a lawsuit, a

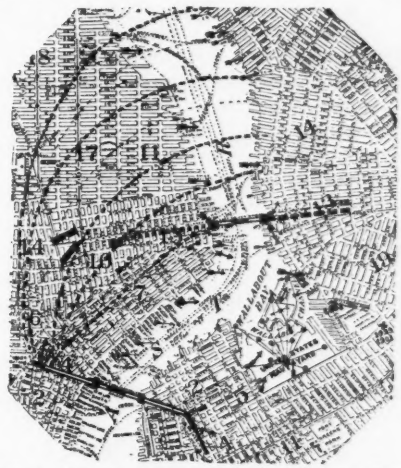


FIG. 2.—MAP SHOWING PATH OF ELECTRIC CURRENTS, BROOKLYN AND NEW YORK.

further survey was made by the writer in this section of the city, for the purpose of ascertaining, if there were currents of electricity flowing through underground pipes, what direction they were taking, and their identity and source. It was discovered, as will be seen by the direction of the arrows and curve lines upon the map, that a portion of the Brooklyn railway currents generated at the Kent avenue power station, in their return to that station pass over the New York and Brooklyn bridge to Manhattan, thence flow through underground pipes as far north as Twenty-third street, and flow east toward the river through pipes in streets running east and west, and also returning over the new East River bridge.

On the Brooklyn side of the river the currents were found to be leaving the river, and passing into the underground pipes as far north as Greenpoint at about opposite Twenty-third street, Manhattan, thence flowing north to their starting point, the power station in Kent avenue.

Further tests between the structure and

pipes in Brooklyn were as follows: about one block from the river, difference of potential two-volts, bridge positive to mains. Two blocks from the river, 2.5 volts, same direction of current. These latter tests indicate that by no means is all of the current which passes over the bridge to Brooklyn, which is considerable, passing through the six-inch pipe, that is but one outlet, other outlets are such parts of the metal structure as may connect with the earth, where the resistance is sufficiently low, and at such place corrosion is possible.

The new bridge is therefore taking the larger portion of straying railway current which formerly passed through the underground pipes in Manhattan to the north, or in other words it is in such position that it invites a more direct return path for these currents to flow back to the Brooklyn power station. This new return path will continue to improve as a conductor, as the bridge nears completion, when more current will be diverted in this direction, unless some method is devised to control it; the readings taken this year were made after the roadway had been joined, which may account largely for the increased flow indicated over last year.

Several water and gas mains have burst in Brooklyn, owing to electrolysis. We will, however, refer only to those of which a record has been kept in the section of the city we have been considering. Two views will be shown, the only ones photographed so far as known. Fig. 4 represents an eight-inch water main which burst in Flushing avenue, near Classon avenue, near the Navy Yard Hospital grounds, July 14, 1899, as shown by the records of the water department.

All the characteristics of electrolysis were found upon this section of pipe, *viz.*, the soft state of the iron in several places which was reduced to a condition of graphite, easily shaved with a pocket knife. The voltmeter readings which we took from where this pipe was removed showed it positive to the rails; besides it was resting in wet soil. The pipe from which this sample was taken was of the Scotch iron make, which is identified by the bulging rings found on every length; they are from three to four inches wide; one of these rings can be seen at the left of this section; this make of pipe is further identified by the lengths being nine feet instead of twelve feet. The hub is also deeper. Subsequently to the bursting of this main at this point, there have been three other failures upon the same pipe in this street within short distances from each other; according to the records there was a failure on March 13, 1901, one on June 25, 1901, and another on November 7, 1901. Two of these damaged sections we have not seen, but we are informed by the men who removed them that the iron was in practically the same condition as to holes and soft spots as the sample shown in the photo. There is no doubt therefore that all of these four failures were caused by electrolysis. The next photograph is represented in Fig. 3.

This is a six-inch pipe, and, as you may readily see, represents a clear case of electrolysis. This was taken from Wallabout place, near Washington avenue, a short distance from the canal. This pipe was positive to rails on Washington avenue, positive to canal, and positive to gas main in same street. The highest reading found was 5.9 volts to rails.

A few years ago an impression prevailed to some extent, that underground mains in Brooklyn were immune from electrolysis. Some gave as a reason, that, as many of the mains were made of Scotch iron, it was thought there was something about the construction of that metal which resisted the effects of electrolytic action.

Another reason was advanced by Professor Sheldon in his paper entitled "Conditions of Electrolytic Corrosion in Brooklyn," read before the American Institute of Electrical Engineers, June 17, 1900, in which he mentioned his discovery of a thin "silicious compound" of the nature of glass, found upon the surface of pipes, formed there during the process of casting, and attributed that as the "true cause of immunity" as that material was an insulator. In view of the fact of many failures of pipes in Brooklyn since 1899, due to electrolysis, several samples of which we have personally seen (two being shown in this paper, one of the Scotch iron make), it would seem that neither of the above reasons as to immunity will stand.

Professor Sheldon also states that this coating is extremely thin and contains perforations.

Such a condition we should consider a good reason for an earlier rupture of a main, than if the corrosion were more evenly distributed over the surface, as at the perforations or spots where there is no coating the action would naturally localize, and the iron be penetrated more rapidly.

We have noticed in the large majority of electrolytic effects upon cast-iron mains, that those spots that are longer one way than another, very frequently take a position at right angles to the length of the pipe, as shown in one of the cuts. These lengths of pipe while being handled, are often rolled over other lengths or hard surfaces, and this may cause a removal of the coating spoken of at such spots, and the consequent localizing of electrolytic action, which follows the line of the bare iron. This is a suggestion of a further reason that such coating is present, although we can find no comfort as to its presence being a remedy against electrolysis, but rather the reverse. We have recently seen a chart showing the entire surface of a twelve-foot, forty-eight-inch main taken from a street in another city, upon which were eighty furrows and pittings, caused by electrolysis. Of the eighty which showed a length as well as breadth, all but five (which were quite small) were transverse with the length of the pipe. One was over two feet long and five-sixteenths of an inch at its deepest point. Others were shorter and some deeper, the deepest being nine-sixteenths of an inch.

National Electric Light Association.

The New England Passenger Association, the Trunk Line Association, the Western Passenger Association, and the Southeastern Passenger Association have granted a rate of a fare and a third, on the certificate plan, from all points in their respective territories to Chicago and return for members and delegates attending the twenty-sixth convention of the National Electric Light Association, to be held in Chicago, May 26, 27 and 28.

The National Electric Contractors' Association.

The third annual convention of the National Electric Contractors' Association of the United States will be held in the Light Guard Armory, Detroit, Mich., July 14, 15 and 16, 1903.

The members of this association include the leading electrical contractors of fifteen states and it is expected that a large number of the members will attend this convention. In connection with the convention an exhibition of apparatus and supplies will be held and the proceeds from the exhibition will be used for the entertaining of the delegates and exhibitors. This exhibition provides the manufacturers and agents an excellent opportunity of showing their goods to the contractors of the country.

Mr. Frank J. Miner, 307 Jefferson avenue, Detroit, Mich., is chairman of the Exhibition Committee.

SAFETY DEVICES IN CENTRAL STATIONS AND SUBSTATIONS.[1]

BY PHILIP TORCHIO.

The importance attached by central station managers and consumers to the reliability of service has been brought to bear so strongly upon the designing engineers and manufacturers of high-tension apparatus that the problem of safety has received, and is still receiving even in its details, the study of every engineer identified with high-tension central station work. This applies not only to the designing but also to the installing and operating of central station apparatus.

What has been achieved is therefore the work of many men, of many experiments, often failures and costly trials and worries; and even now it can not be said that the problem has found its final and general solution. Therefore I shall approach the subject along broad lines, so as to invite discussion and suggestions on the characteristic features aiming to increase the factor of safety or to ensure continuity of service.

High-tension transmission systems may be overhead or underground, or composite overhead and underground. For moderately high voltages, up to 15,000 volts, the transmitted current can be generated directly or can be obtained from step-up transformers. For higher voltages step-up current only has been used up to the present time. All these different conditions create special requirements for each individual system. In this brief review no attempt has been made to enter into special details particular to any individual case. What follows applies more or less generally to all systems.

Mechanical Reliability—In this connection no attempt has been made to deal with the feature of mechanical reliability of the generating systems, though it is as important for the mechanical equipment to be safe and reliable as it is for the electrical equipment to be so. In fact the general principle of subdivision and independence of different generating units may be considered to find its application throughout—from coal supply at the boilers, through the mechanical and electrical equipment at station and transmitting lines, to the receiving substations.

Electrical Reliability—Proceeding from the generating station to the transmission line and receiving substations, we find the following characteristic features more or less generally adopted or considered desirable from the aspect of reliability of service. Some of the safeguards given in the list appears perhaps as unnecessary and expensive refinements, and probably they would be so for a large number of cases where continuity of service may not be considered absolutely essential. In a large situation, for instance the lighting and power of a large city, the conditions are different; and if for these conditions safety can not be obtained in any other manner, these refinements become of paramount importance.

GENERATING STATION.

1. Installation of storage battery on field exciter bus, at generating station.

2. Equipment of reverse current relays and circuit-breakers on exciter generators.

3. Equipment of overload relays with time limit and circuit-breakers, on motors of motor-generator exciter sets.

4. Separation and mechanical protection of generator leads of different generators. Also proper insulation and protection against capacity discharges of cable leads.

5. Connection of each generator to bus-bars by means of two oil switches in series, preferably arranged to close independently and open at the same instant.

6. Subdivision of bus-bars, in different sections, enabling operation of generators in different groups. Also selector switches on each generator, enabling the same to be operated on at least two sections of bus-bars.

7. Tie connections between different sections of bus-bars, enabling us to make, if desired, combinations of different sections or even one common bus-bar.

8. Overload and reverse current relays on generator switches, these being connected to signal lamps until they have proven their reliability for actual tripping of main switches.

9. Selector switches on feeders providing means of connecting each feeder to at least two selectors of bus-bars.

10. Duplication of oil switches on each feeder circuit, preferably arranged to close independently and open at same time.

11. Overload relays on each feeder, with a variable time limit, in inverse proportion to the amount of current.

12. Separation of all wiring and busses inside the station by means of ducts, fireproof septums and grooves in walls, and proper protection against capacity discharges, by the use of good glass or porcelain insulators.

13. In connection with very high voltage step-up transformers, provide low-tension synchronizing busses for generators and switches on the low-tension side of step-up transformers, thereby avoiding synchronizing of the high-tension side of transformers, or closing of the high-tension switches on dead transformers.

14. Avoid installation of single pole main switches for each phase of the circuit, and also synchronizing with one pole switch closed and synchronizing transformer across the gap of the other pole switch.

TRANSMISSION LINE.

15. Duplication of transmitting lines to important centres of distribution, selecting if possible different subway routes, or independent transmission lines.

16. Mounting of suitable end boxes on ends of cables at all terminals. Also possible equipment of spark arresters on each end of underground cables.

17. Protection of underground cables in ducts by the use of good fireproof materials.

18. Protection of cables in manholes, using preferably separate manholes for high-tension cables, with asbestos or iron covers on each cable, etc.

19. Protection of lead sheath of cables against electrolysis, either by laying cables in vitrified ducts and rubber cushioned racks in manholes, thereby making the cable insulated from ground along its route, or laying heavy bare copper wires along the route of cables and connecting solidly to their lead covers in each manhole, these wires providing a secure metallic path for the current, which leaves the cable sheaths to return to the grounded bus at the railway station *via* the wires suitably connected to the railway return feeders.

20. Protection of transmitting and receiving stations operating overhead transmitting lines by improved lightning arresters.

21. Grounding of neutral of three-phase transmission lines for very high voltages. (General practice in the California transmission plants.) In the case of very high voltages, this grounding seems a necessity.

22. Possibly grounding of neutral for lower voltages and underground cables. (This is done in several places, as, for instance, in Chicago, on the 2,200-volt, three-phase, four-wire, sixty-cycle system, as well as on the 9,000-volt, three-phase, twenty-five-cycle star-connected system.) From the point of view of reducing strains on insulation, this grounding of neutral seems unnecessary for moderate voltages, though it could be made use of for locating accidental grounds on the system, and in indicating and eventually disconnecting the affected feeder, which would be troublesome to locate on a system without grounded neutral and operating several feeders from same bus-bars.

23. Avoid operation of high-tension lines at different frequencies when lines are mounted on same pole line. This to avoid doubling of strain on insulators when two wires of different lines become crossed.

(To be concluded.)

[1] A paper read at the 176th meeting of the American Institute of Electrical Engineers, New York, April 24, 1903.

The Cascade Water, Power and Light Company, Cascade, B. C., Canada.

By W. G. McConnon.

ALL of the gold extracted from water is not taken directly in the form of metal. A power-house for generating electricity proves a very efficient "stamp mill" for delivering "concentrates" in the form of volts. That this is appreciated by mining men is evidenced by the recently completed plant of the Cascade Water, Power and Light Company, situated at Cascade, British Columbia, and owned by the London & British Columbia Goldfields Company, Limited, representing an investment, in round numbers, of $500,000.

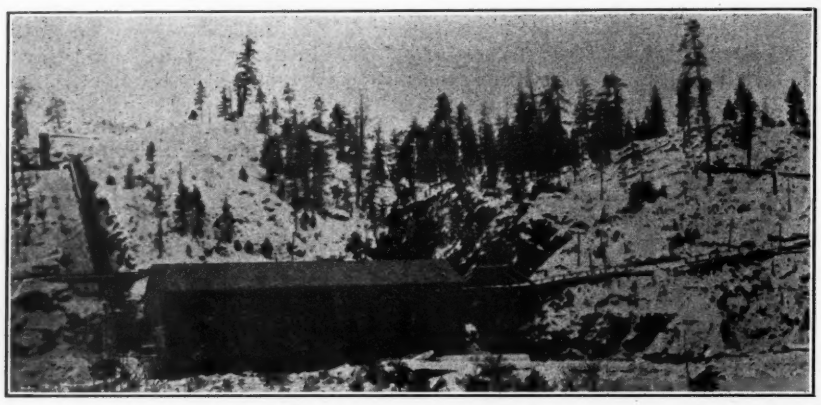


FIG. 1.—GENERAL VIEW OF THE POWER-HOUSE OF THE CASCADE WATER, POWER AND LIGHT COMPANY, CASCADE, B. C., CANADA.

Cascade is a small town on the Kettle River, twelve miles east of the town of Grand Forks, and about thirty miles directly west from Rossland, British Columbia. Flowing from the west, the Kettle River descends 120 feet in passing through a half mile of narrow rocky gorge in a series of rapids and falls. For the utilization of this natural power, the Cascade Water, Power and Light Company has built a large dam, waterway, pipe line, power-house, and transmission line from Cascade to Phœnix, where the largest and most productive copper mines in the "Boundary District" are situated.

The dam, placed just above the entrance to the gorge, is of timber cribwork, with a 40-foot base and 24-foot top. The midsection is 50 feet high, tapering to 25 feet at the sides, while the total length is 400 feet. This is built on a solid rock bed to which the foundation timbers are bolted, and filled with 10,000 cubic yards of rock. This dam raises the water 36 feet above the natural level, giving an effective head at low water of 156 feet.

The permanent water level is 10 feet below the top of the dam, being controlled during high water by twelve sluiceways which can be opened to 12 feet below the natural river level, giving a passway of about 2,000 square feet. These sluices are closed by means of 12-inch x 12-inch squared timbers in grooves, operated by a traveling winch running on a track over the top of the dam.

From dam to power-house the water first passes through a 225-foot open rock cut from which it enters a tunnel driven through 410 feet of solid rock, passing under the track of the Canadian Pacific Railway, and then into another open rock cut 500 feet in length, at the end of which the bulkheads and controlling gates are located. These cuts and tunnel, representing an excavation of about 35,000 cubic yards of rock, are of dimensions liberal enough to avoid any appreciable loss of head, delivering the water with a head almost equal to that at the dam level.

From the gates the water is conveyed through a wooden pipe, 7 feet in diameter, for about 1,400 feet. This pipe is constructed of Oregon fir, tongued and grooved staves 2¾ inches x 7 inches, cut in circular segments and machined to the radius of the pipe. The staves are hooped at 12-inch intervals, with ¾-inch round steel bands, with cast-iron connecting shoes for clamping.

Provisions have been made at the bulkhead and in the width of the cut for the installation of a similar and additional pipe.

From the stave pipe the water is carried through 250 feet of circular steel pipe, 7 feet in diameter, resting on concrete piers and anchored into solid rock to avoid end-thrust. Where this pipe passes alongside of the power-house, three 4-foot pipes and one 2-foot pipe are taken off below the floor level of the power-house to supply three 36-inch turbines for generators and two 12-inch turbines for exciters.

FIG. 2.—THE INTERIOR OF THE POWER-HOUSE AND THE GENERATING PLANT.

Fig. 1 is a general view of the power-house, showing the stand-pipe at the junction of the stave and steel pipes. This stand-pipe relieves the pipe line from excessive water-ram strains, and incidentally voids any air taken into the pipes.

About 10,000 cubic yards of rock were

removed for the site of the power-house, in a natural bay at the foot of the falls. This building is of substantial fireproof construction, 150 feet x 50 feet, with stone foundation 22 feet deep on the lower side, and brick walls 30 feet above floor level, the height to peak of roof being 45 feet. It has been designed with a view to lengthening it when required.

Fig. 2 shows the interior of the power-house, and the generating plant. The three generators are standard Westinghouse, three-phase, two-bearing, direct-coupled, 2,200-volt, 750-kilowatt, at 80 per cent power-factor, or 940-kilowatt, at 100 per cent power-factor, 60 cycles per second, 300 revolutions per minute. The two exciters, each capable of exciting all three generators at one time, are 45-kilowatt, 120-volt, shunt-wound dynamos, self-contained, two-bearing type, direct-coupled to independent turbines, with 500 revolutions per minute. The turbines are H. Morgan Smith wheels made at York, Pa., and the governors the Escher, Wyss & Company's make, from Zurich, Switzerland.

Fig. 3 shows the transformers, nine in all, three in each bank, which are standard Westinghouse, self-cooling, oil-insulated type, having a capacity of 250 kilowatts at 80 per cent power-factor, or 312½ kilowatts at 100 per cent power-factor, "star" connection, and wound for a ratio of 2,000 to 20,000 volts, on both high and low-tension windings, with full load efficiency of 97.6 per cent. As the taps are brought out near the neutral point, which is grounded, it is impossible to maintain a dangerous voltage in the auxiliary circuit.

Fig. 3.—Showing the Three Banks of Transformers.

The current from the high-tension side of the transformers is carried to a row of high-tension fused circuit-breakers, situated alongside of the building behind the main switchboard, as shown in Fig. 3. These switches are of the well-known Westinghouse type, placed on independent marble slabs, with marble barriers between. The current, leaving these switches, enters a high-tension bus and is carried to the line switches at the rear of the building. These line switches are grouped switches opening all three wires at the same time. Each switch is furnished with a time limit tripping device, and reversed current tripping coils, so that overloads can be carried for a period of from one to ten seconds, as the local conditions call for, or either line can be cut out automatically in case of trouble.

The switchboard for the low pressure side, Fig. 4, consists of seven panels of blue Vermont marble, one panel for each generator, one for the two exciters, and a feeder panel for each group of transformers.

The six lightning arresters, located just above the switches in the gable of the roof, are the "low equivalent" style of the Westinghouse Electric and Manufacturing Company, giving protection against lightning discharges for transmission at 20,000 volts.

A right of way 132 feet wide is cleared,

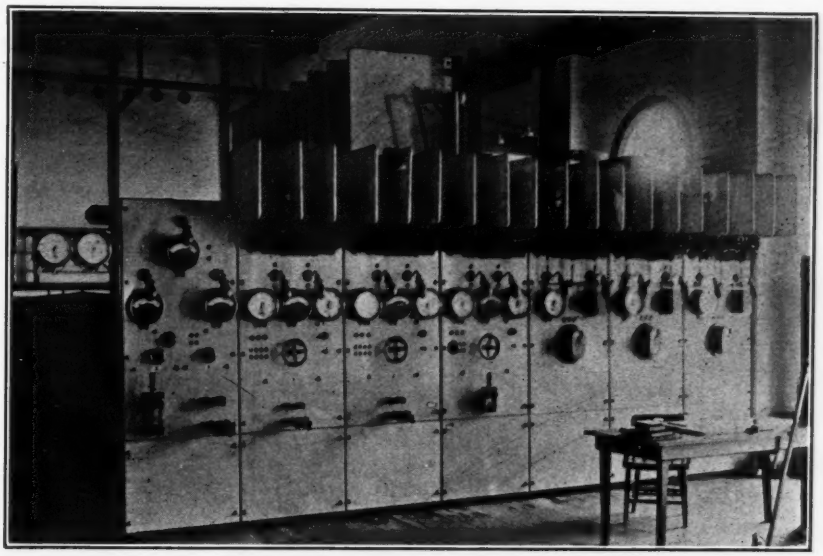


Fig. 4.—Low Pressure Switchboard.

and transmission lines erected from Cascade *via* Grand Forks to Phœnix, a distance slightly over twenty-one miles.

The high-tension circuit consists of two separate three-phase transmission lines, each carrying three No. 3 B. & S. copper wires, with room on each line for another circuit. Throughout it is one of the most substantial and well constructed lines in the Dominion.

The poles are heavy cedar, and on tangents are spaced not over 100 feet apart, on curves at less distances, in some cases as low as 50 feet. No angles are turned, but all changes in direction of line made with easy curves. No side or head guys have been used except at extra heavy spans across rivers, etc.

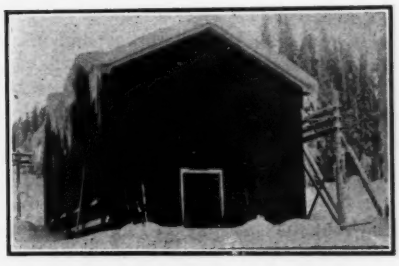


Fig. 5.—The Substation at Phœnix.

The work on this line, as well as all construction of the plant, is a decided credit to the company's local engineer, Mr. Wm. Anderson, who has designed and executed the work.

A three-mile feeder is taken off at Grand Forks, twelve miles from Cascade, to the Granby smelter of the Granby Mining and Smelting Company, where current is used for driving Westinghouse induction motors of sizes ranging from three to seven hundred horse-power, and of an aggregate capacity of 2,400 horse-power.

Fig. 5 is a view of the substation at Phœnix, located at an altitude of about 3,500 feet above the power-house. The building is of brick, with one end left for future extension, and contains the transformers, line switches, fused circuit-breakers, switchboards, etc., substantially duplicating those at the power-house. Fig. 6 shows the interior of this substation, which, for the immediate present,

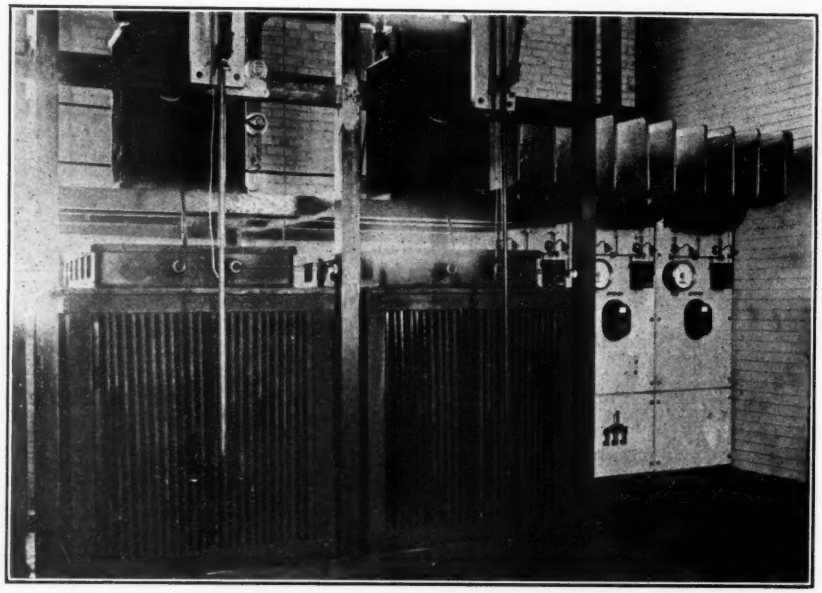


FIG. 6.—INTERIOR OF SUBSTATION AT PHŒNIX.

will be called upon to supply current for two 700-horse-power motors for driving two large compressors, a 100-horse-power motor for stone crusher, and a 150-horse-power motor for hoist, as well as furnishing the current for lighting the town of Phœnix.

The Cascade Water, Power and Light Company estimates that it will have a supply, at low water, for about 6,200 horse-power. This will enable the doubling of the present output. All the plans were made and carried out with the view of extending the plant to its full capacity, and from present indications it would seem that the company will have a demand for all the power it can furnish.

Commercial Vehicle Contest.

The commercial vehicle contest to be held by the Automobile Club of America in New York city, May 20 and 21, will afford an opportunity for observation as to whether self-propelled vehicles can be used with greater economy than horse-drawn vehicles in commercial service.

DISTRIBUTION LOSSES IN ELECTRIC SUPPLY SYSTEMS—III.

BY A. D. CONSTABLE AND E. FAWSSETT.

SUMMARY AND CONCLUSIONS.

So far, the losses have been enumerated without much reference to the total output of the station. In table VI the whole of the losses are summarized and expressed as percentages of the total units generated and the total units sold. Diagram 7 is a graphic representation of the losses as they occur in the system.

It will be seen from the table that the calculated loss is twenty-two per cent of the units sent out of the station. From the actual sum of the consumers' meter readings, however, the loss appears to be only 18.4 per cent. This difference of 3.6 per cent is no doubt partly due to a rather liberal estimate of the losses in some cases; numerous approximations are required, and it is impossible to calculate the losses with great accuracy. It may also be partly due to small errors in the meter. The total units generated depend on the average accuracy of seven meters, while the total sold depends on 1,200—a difference of two or three per cent may thus easily occur.

There is a further side to the question which, however, as it hardly comes within the scope of this paper, will be briefly dealt with. It may be economical to waste energy as long as interest has to be paid on borrowed money. It is, of course, possible to reduce C^2R losses, at any rate to a negligible amount, by putting in enough copper, but it is not economical to do so. It is the duty of the engineer to design a system which shall give the best result for the least annual expenditure; he must avoid losses in transmission up to the point where the expense of avoiding them becomes greater than the cost of the energy lost. A case illustrating the comparative advantages of two alternative schemes is the following:

A certain portion of the district considered in this paper was originally supplied with alternating current from four substations, fed at 2,000 volts. After a few years the load became much heavier than at first, and it was found both more economical and advisable for other reasons to change the supply to direct current without transformation, using the same low-tension mains, instead of adding to the section of the existing cables. The total losses per annum under the old system amounted to 49,100 units. With the new system for the same load the losses are 40,300 per annum, so that there is a saving of 8,800 units in favor of the direct-current supply, and the cost of the alteration was considerably less than that of the other alternative. The average distance of these substations from the generating station is 1,290 yards, or about three-quarters of a mile, and the maximum load is about 400 kilowatts in all.

With regard to the means for reducing the losses in general to a minimum, the methods to be adopted have been mentioned under the various sections of this paper, but they may be summarized here. Primarily, good design is necessary; after that, care must be taken to remove useless causes of waste during times of light load.

The cure for waste of energy in switchboards and station connections is simple design, good workmanship, and choice of suitable positions. Cable losses may be reduced, assuming suitable dielectrics have been selected, by switching off high-tension cables not required for load, but as in most cases the saving by doing this is small, the extra risk of cable breakdowns more than counterbalances it.

C^2R losses in the low-tension system may be cut down by interconnecting the network so as to use all the copper laid down, to the best advantage. Fuses between the various sections must be relied on in case of breakdown if this is done.

Transformer losses during light loads are, of course, reduced by switching out transformers which are not necessary. This practice is not, in the opinion of the authors, detrimental to the safety of a well-made transformer. It may certainly pay in some cases to scrap transformers

of an old and wasteful type, rather than to use them until they are worn out. It may be worth while to either artificially alter the wave shape during the day, or to run machines with a peaked wave in order to reduce the core loss.

It is hardly admissible to alter the frequency unless no motors whatever are in use.

To remove the largest source of loss that the number of consumers per mile of mains is small. This accounts for part of the large C^2R losses, but even so the remainder is of very considerable magnitude, and there must be many supply systems working under worse conditions. The engineers of these systems will, however, probably feel hurt if they are told that they are guilty of slowly, but surely, throwing away the coal resources of the

—	Quarters.								Year.		Percentage of units generated.	Percentage of units sent out.
	May, June, July.		Aug., Sept., Oct.		Nov., Dec., Jan.		Feb., Mar., April.					
Losses in switchboards and connections	...	600	...	2,000	..	5,000	...	2,400	..	10,000	0·51	0·54
Cable losses: H.T. Leakage and dielectric hysteresis	4,100	...	4,100	...	4,100	..	4,100	...	16,400	...	...	...
H.T. C^2R	3,400	...	10,600	...	22,300	...	11,000	...	47,200	...	...	...
Cable losses: L.T. Leakage and dielectric hysteresis	500	...	500	...	500	...	500	...	2,000	...	...	...
L.T. C^2R	6,800	...	16,570	...	25,400	...	17,500	...	66,200	...	...	...
C^2R loss in H.T. and L.T. arc cables	4,640	...	8,710	...	13,820	...	10,030	...	37,200	...	...	...
Total cable losses	..	19,440	...	40,410	...	66,020	..	43,130	...	169,000	8·7	9·2
Transformer losses: Core loss	26,000	..	27,000	..	29,000	...	27,500	..	109,500	...	...	...
Copper loss	9,500	...	17,400	...	19,400	...	17,400	...	63,700	...	...	...
Total transformer losses	...	35,500	...	44,400	...	48,400	...	44,900	...	173,200	8·9	9·4
Meter losses: C^2R	60	..	370	...	850	...	470	..	1,750	...	...	...
Shunt	12,500	...	12,800	...	13,400	...	12,800	...	51,500	...	...	...
Total meter losses	...	12,560	...	13,170	...	14,250	...	13,270	...	53,250	2·7	2·9
Total losses	...	68,100	...	99,980	..	133,670	...	103,700	...	405,450	20·8	22·0
Per cent of units sent out	...	33·4	...	24·6	...	18·5	..	20·5	...	22·0	...	...
Units generated	...	223,000	...	423,000	...	764,000	...	538,000	...	1,948,000	100	...
Units sent out	...	204,000	...	403,000	...	724,000	...	506,000	...	1,837,000	94·4	100
Units sold (a)	...	135,900	...	303,020	...	590,330	...	408,300	...	1,431,550	73·4	78·0
Units sold (b). Sum of consumers' meter readings	...	139,000	...	344,000	...	638,000	...	381,000	...	1,502,000	77·0	81·7
Per cent. units sold to units generated	...	61	...	72	...	77	...	75	...	73·4(a) / 77·0(b)	...	...

TABLE VI.

in meters, shunts should be abolished, as discussed in the section on meters.

Although this paper deals with the Croydon system of distribution, the arguments hold good generally, whether the supply is by means of alternating or direct current. The question of losses in tramways or power schemes is considerably modified, however, by the altered conditions of working. There are in such cases only a few hours of light load instead of the larger part of the day, and as the losses will be practically all C^2R loss in the cables, much heavier copper must be put in to secure the most economical working.

The losses detailed in this paper are incurred in a system which is indisputably, on the whole, well arranged and economically worked. The district has the disadvantage of being a very extended one, so empire, and that they are, therefore, neither serving the profession nor their country in the highest degree.

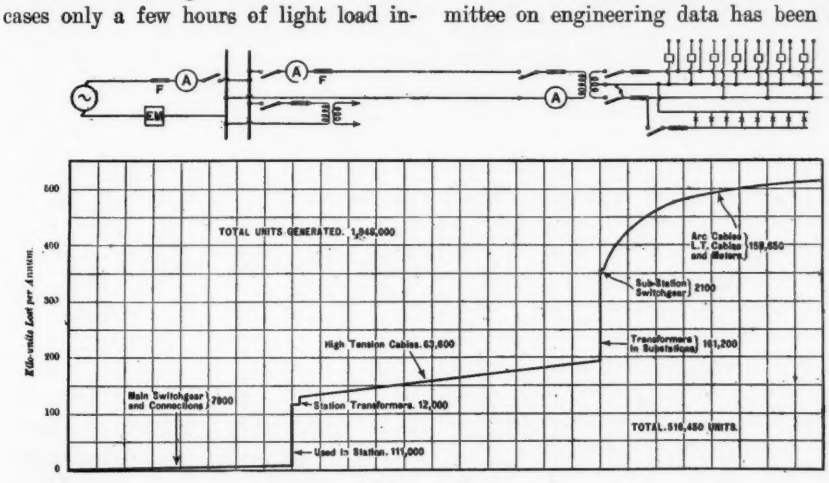


DIAGRAM 7.

The American Institute of Electrical Engineers, Committee on Engineering Data.

In accordance with the action of the board of directors of the American Institute of Electrical Engineers, the committee on engineering data has been appointed. Mr. H. W. Buck, of Niagara Falls, N. Y., is chairman, and he will be assisted by the following gentlemen: H. A. Foster, C. L. Mailloux, H. W. Fisher and W. L. Robb. This committee has been appointed for the purpose of collecting and publishing for the benefit of the members of the Institute, data of use in the electrical engineering profession. This information will be especially with regard to new and special subjects. Many men have curves, short methods, empirical formulæ and special data on subjects which are of great value, but not considered to be of sufficient magnitude or importance to constitute an article for the technical press, or for an Institute paper. This committee will seek to get in touch with such men, and, with their cooperation, to bring the data into publication for the benefit of the electrical engineering profession. A prospectus will soon be issued to all the members of the Institute, in which the objects and scope of the proposed work of the committee will be set forth in detail, together with the proposed method of publication.

The Application of Three-Phase Motors to the Electrical Driving of Workshops and Factories.

In a recent paper before the Society of Arts, London, Mr. A. C. Eborall discussed the advantages of three-phase motors for factory driving. The author believes that for most classes of work the induction motor is preferable to the continuous-current motor, owing to its flexibility, reliability and economy in the cost of installation and maintenance. It is able to stand overload and rough treatment, and is only at a disadvantage when economical speed regulation is required. For small powers, and where a large starting torque is not required, the squirrel-cage motor is ideal for constant-speed work. The problem of starting induction motors under load is discussed, and a table shows the performance of different types of motor. As regards speed variation, this is generally of minor importance in workshops and factories, as shafts are driven at a practically constant speed. For textile mill driving, three-phase motors can be used with the best results, and meet the conditions better than continuous-current motors. For cotton and woolen mills, the best arrangement is to drive groups of machines from one motor. For silk weaving, individual driving of the looms is the ideal method. Stress was laid upon the following points, bearing on the satisfactory and economical working of a three-phase installation for power purposes: The pressure drop in the generators should not exceed sixteen to eighteen per cent from no load to full load; high speed is favorable to good performance in this respect; the power-factor of the motor should be as high as possible over a wide range of load, and above three horse-power it should be not less than 0.8. The efficiency curve should be as flat as possible over the working range of load. A proper starting performance should be insisted upon, and short-circuited rotors should be installed with discretion in the larger sizes.

Lignite, Peat and Coal-Dust Fuel in Germany.

In response to a number of enquiries from American engineers, Mr. Frank H. Mason, consul general at Berlin, Germany, has prepared the following study:

I.—THE LIGNITE BRIQUETTE MANUFACTURE.

It has been repeatedly stated that the outward cleanliness of Berlin and other German cities is principally due to the general consumption of brown coal briquettes for household and steam fuel; further, that they are made from ordinary German lignite without the use of tar or other artificial binder; that they are compact to store, clean to handle, easy to kindle, burn with a clear, strong flame, are cheaper than good bituminous coal, and are made practically smokeless. Lignite varies in its value and adaptability for briquetting purposes according to its geologic age, hardness, and the percentage of water contained. A lignite with less than thirty per cent of water is very difficult to work by the usual processes, and it is for this reason that Austria-Hungary, which has an abundance of very old and hard brown coal that contains from twenty-six to twenty-eight per cent of moisture, has practically no supply of briquettes from that source. German lignite, on the other hand, is of much more recent formation; it contains from forty-six to fifty-two per cent of water, and is usually so soft that it can be cut with a spade. Many lignite beds in this country are filled with logs and pieces of wood, so well preserved in the matrix of partially carbonized material that they burn readily and form a cheap and abundant fuel for steam and other heating at the briquette factories. The part played by the water contained in lignite forms the key to the whole economic briquetting process. The crude brown coal is brought from the mine, crushed and pulverized, and then run through a large revolving tubular cylinder, heated by exhaust steam from the driving engine, and hung on an inclined plane so that the powdered material runs downward through the tubes by gravity, and is carried into the machine press that stamps it into briquettes. During this passage through the cylinder, it is dried and heated until there remains the right proportion of moisture combined with the proper temperature to develop the latent bitumen in the lignite and make the powdered mass plastic and easy to mould under heavy pressure between heated iron jaws into a hard, clean briquette, with a glistening surface and sufficient firmness of structure to stand weather, transportation, and other contingencies. To do this perfectly and economically, the natural lignite should contain as it comes from the mine, approximately enough water so that heating to the proper temperature for pressing will evaporate out just sufficient water to leave it at the proper degree of moisture. The ideal proportion is about forty-five per cent of water, so that German lignite contains rather too much, while Austrian contains much too little, though this latter difficulty has lately been partially overcome by steaming. The important question to be now decided is how American lignite will fulfill these requirements.

During the past six weeks, samples of lignite from near Bismarck, N. Dak., and from Troy, Ala., have been received at this consulate, turned over to the syndicate mentioned in a previous report, and moulded experimentally into briquettes with entire success. The Dakota lignite is old and hard, contains thirty-eight per cent of water, but crushes and pulverizes easily and forms without binder briquettes of firm structure, which burn readily, are practically smokeless, and leave only four per cent of ash, while the best German brown coal briquettes yield from nine to twelve per cent of inorganic residue. The percentage of water contained is rather low, but by adapting the heating-drying process to that proportion of moisture, this obstacle, such as it is, can be easily met, and the reduced task of evaporation will be an economy in the general process.

The Alabama lignite, on the other hand, is an ideal material, and from the one sample submitted is conceded here to be even superior to the standard brown coals of Germany. It contains the correct percentage of moisture, crushes easily, and moulds readily into firm, shining, black briquettes, so clean that, as one of the experts at Magdeburg said, "They might be used for paper weights."

The importance of these simple demonstrations will be inferred from the fact that, according to a recent state geological report, there are 55,000 square miles of lignite beds in the Dakotas and Montana, all near the surface of the ground, and ranging in thickness from twenty to eighty feet. The extent of the lignite deposits in the Gulf States is perhaps less exactly known, but they certainly cover a large area. There is also lignite in Missouri, Iowa, and several other western states and territories, and it is from all those hitherto practically neglected deposits that an inexhaustible future supply of smokeless domestic fuel will be derived. It will, therefore, be of interest to state concisely what constitutes a first-class, up-to-date lignite briquette factory in Germany, where the industry has reached, after many years' experience, its highest development. A typical example is the factory at Lauchhammer, about eighty miles south of Berlin, on the direct line to Dresden. This establishment, which is of the latest and most approved construction, has eight presses, with the necessary pulverizing, heating, and drying plant, run by electric motors with current generated by steam evaporated with wood from the mines, the whole under handsome, substantial buildings of brick, stone, and iron; and cost, with tracks, switches, and full equipment for handling raw material and loading the briquettes into cars, $371,000, of which $178,500 was paid for machinery. Each press weighs thirty-two metric tons and stamps out 100 to 120 briquettes per minute, or seventy tons in a double-turn day's work of twenty hours. The heating and drying apparatus for each press weighs eighteen tons. The power required for each press and dryer is 125 horse-power, and both the dryer and jaws of the press between which the briquettes are squeezed at enormous pressure are heated by exhaust steam from the Corliss engine in the power-house, the whole supply for the eight machines being equivalent to about 150 horse-power.

Thus equipped, the plant at Lauchhammer turns out from 500 to 600 tons of briquettes per day, which sell on cars at the factory for from seven to nine marks ($1.66 to $2.14), according to season and market, with an average of eight marks ($1.90) per 1,000 kilogrammes, or metric tons of 2,204 pounds. Profits depend on the usual varying conditions, location, management, demands, etc., but it is common to read in the Berlin papers official notices announcing dividends of brown coal briquette companies ranging from fifteen to twenty per cent of their capital. So enormously has the industry been developed in recent years that there is now an overproduction, and it is said that 100,000 carloads (1,000,000 tons) of briquettes will be carried over to the fuel supply of next summer and autumn.

II.—THE UTILIZATION OF PEAT.

Peat as a material for fuel ranks next in natural order below lignite, in that it

is of similar but much more recent geological origin, contains more water, is but slightly carbonized, and has a correspondingly lower thermal value than brown coal. The task of converting peat into serviceable fuel consists in cleaning the material of roots and rubbish, reducing the water to a small percentage, and so condensing the peat in volume that its thermal value shall be raised to practical efficiency. This is done by various methods, some of which are in this country as yet partially covered by patents, but they may all be grouped under three heads, according to the form which the ultimate product is to assume, *viz.*, (1) compressed peat, with or without admixture of coal dust or other inflammable matter; (2) peat coke; and (3) briquettes made by compression, with or without heat, of the material prepared by the first of these processes.

COMPRESSED PEAT.

A pioneer in the invention of machinery and processes for making compressed peat in nothern Europe appears to have been Mr. C. Schlickeysen, of Rixdorf, near Berlin, whose installation and present methods have been mentioned in a previous report of this series. His first two machines were of vertical construction, and were built in 1859 for a steam peat compressing plant at Zintenhof, near Riga, in Russia, where they worked successfully for many years, turning out daily about 80,000 pieces of wet compressed peat, which, after drying, were used as smokeless fuel in a large cloth factory at that place. During the ensuing forty years, he has built peat compressing plants in Holland, Hungary, Switzerland, and at various places in Germany, constantly improving his equipment and processes with a view of perfecting the product, cheapening its cost, and substituting more and more automatic machinery for manual labor, until the system so evolved may be accepted as standard in this country.

Raw peat, as it comes from the bog, contains about eighty-five per cent water, thirteen per cent combustible material, and two per cent inorganic matter. To obtain the thirteen per cent of combustible elements in the cheapest, most direct manner, the peat is cut with spades and shoveled into the trough of a long, sloping, belt-and-bucket elevator, which carries it up and drops it into a machine which cuts, tears, kneads, and mixes it to uniform consistency, in which state it passes downward and is forced by a horizontal screw into long, plastic skeins, about three by four inches in transverse section; these are delivered at the tail of the machine on boards three feet long, which are lifted off by hand when filled, laid on tram cars, and run out to a cleared space, where they are laid in rows on the ground, and the skeins cut with a knife into bricks or sections ten inches long, which, being left to dry, lose by exposure in ordinary weather one-half their water contents in a period of two weeks. The peat loses by this machine process one-third its bulk, so that a machine which works twenty-one cubic metres (741,636 cubic feet) of raw turf per hour, delivers fourteen cubic metres of clean peat, or 7,000 wet bricks of the size indicated, which contain from three to four tons of dry compressed peat in a condition to be used as fuel. A plant of this kind includes, besides the elevator and grinding-press, a ten-horse-power portable engine, which is fired with peat refuse, and cars and tracks for handling the material. The whole plant is movable, is taken bodily to the bog, set up at the farther edge of the moor to be worked, and moved backward as the peat bed is excavated and exhausted. An important recent improvement by Mr. Schlickeysen is an excavating machine, which, in moors reasonably free from logs and stones, digs and elevates peat with great rapidity, thus saving the hard, wet, unhealthy work of several men. The cost of such a plant, complete, with engine, track, cars, etc., ready to operate, is 18,620 marks ($4,431), and its operation, when used without machine digger, employs seventeen men, besides engineer and fireman, a total cost for labor in North Germany of 120 marks ($28.56) per day. After air-drying on the ground until their water contents are reduced to thirty-eight or forty per cent, the peat blocks are built up in open formation, like bricks in a kiln, to dry until the water is reduced to fifteen to eighteen per cent, when they become a fuel with a thermal value of 3,000 to 4,000 calories. This value may be increased by converting the air-dried peat into briquettes, which is done by heavy pressure with heat in a machine-press specially constructed for the purpose.

One of the important improvements of recent years has been attained by mixing the peat pulp, as it passes through the grinding machine, with other inflammable materials—*viz.*, bituminous coal dust or slack up to thirty per cent, anthracite culm to forty per cent, or dry sawdust to fifteen per cent. These dry, pulverized materials, when mingled with the wet peat, not only greatly enhance its subsequent value as fuel, but facilitate the drying process and render it tough, dense, elastic and capable of being pressed cold into salon briquettes of high quality.

There are in the state of New Jersey, within easy distance of the coast, extensive peat beds which have not hitherto been utilized. There are at the terminal yards at Jersey City and Hoboken large quantities of coal dust, both anthracite and bituminous, that are treated as waste. May not the neglected peat and the worthless dust of the coal yards be combined by processes already perfected and successful here into a clean, cheap and effective fuel for household purposes?

PEAT COKE AND SECONDARY PRODUCTS.

By far the most modern, scientific and rational method of utilizing peat appears to be that of converting it into coke, by carbonization in retort ovens with recovery of the gas, tar and other by-products of distillation. This has been the subject of many years' study and experiment in Germany, the best results of which have been embodied in the system perfected and patented by Martin Zeigler, a chemical engineer of high reputation, which gives to the manufacture of peat coke the dignity of a perfected industrial process. Concisely stated, the Zeigler method consists in carbonizing peat in closed ovens, heated by burning under them the gases generated by the coking process itself. Such a plant is, therefore, self-sustaining, the only fuel required being coal or wood sufficient to heat the oven for the first charge, when the gases generated by the coking process become available and enable the operation to be repeated and continued indefinitely. Not only this, but the off-heat from the retort furnaces passes on and heats the drying chambers in which the raw, wet peat is prepared for the ovens by drying to the point of economical carbonization. There is transmitted to the department, as an exhibit, with this report a sample of one kilogramme (1,000 grammes, or 2.2 pounds) of raw peat and the several products derived therefrom by the Zeigler process, each in its due proportion, as follows: Three hundred and fifty grammes of coke, forty grammes of tar, and four hundred grammes of gas liquor, from which last is derived six grammes of methly alcohol, six grammes of acetate of lime and four grammes of sulphate of

ammonia. If this sample be multiplied a thousandfold, to a metric ton, and the value of each product given at its present market price in Germany, the demonstration would be as follows:

Description.	Value. Marks.	Dollars.
1 ton (1,000 kilogrammes) of peat, costing, dried, 5 marks ($1.19), produces:		
350 kilogrammes (771.6 pounds) of peat coke	15.75	3.75
40 kilogrammes (88.2 pounds) of tar	2.20	0.52
6 kilogrammes (13.2 pounds) of methyl alcohol	4.20	1.00
6 kilogrammes (13.2 pounds) of acetate of lime	0.72	0.17
4 kilogrammes (8.8 pounds) of sulphate of ammonia	0.88	0.21
Total	23.75	5.65

The peat coke produced as the primary product of this process is jet black, resonant, firm and columnal in structure, pure as charcoal from phosphorus or sulphur, and having a thermal value of from 6,776 to 7,042 calories, it is so highly prized as a fuel for smelting foundry iron, copper refining and other metallurgical purposes that it readily commands from forty to fifty marks ($9.52 to $11.90) per ton. It is also a high-class fuel for smelting iron ores, but as the process is comparatively new and the output limited, it is as yet too scarce and expensive for blast-furnace purposes. Crushed and graded to chestnut size, it forms an excellent substitute for anthracite in base-burning stoves. In larger lumps, it comes from the oven, it fulfills substantially all the various uses of wood charcoal as a clean, smokeless fuel. The cost of a four-oven plant, with all apparatus for cutting and drying the peat, distilling the gas liquor, and extracting paraffin from the tar, is given at $95,200. Such a plant is reckoned capable of working up annually 15,000 tons of peat, the various products of which would sell, at present market prices, 494,100 marks ($117,596). A plant of twelve ovens, with all appurtenances complete, would cost $261,800 in Germany, and should produce annually products worth $350,000, from which, deducting the carefully estimated cost of peat, labor, depreciation of property, and other expenses—$179,200—there would remain a profit on the year's operation of $170,800. This process is in successful operation at Redkino, in Russia, and the German Government has evinced its practical interest in the subject by placing at the disposal of the company a large tract of peat moor lands, the property of the state, on which extensive works will be erected during the coming year.

III.—COAL-DUST BRIQUETTES.

While Germany is preeminent in the scientific utilization of lignite and peat as materials for prepared fuel, it is not apparent that this technical superiority is so absolute in the treatment of coal dust. It is true that the coal briquette manufacture is fully organized and developed in this country, that there are several German builders of coal briquetting machinery who are masters of that branch of construction, but the same is true of France, Belgium and England, where the conversion of coal waste into briquettes for locomotive and other steam fuel, as well as for grates and heating stoves, has long been a standard and established industry. It is not known that it has anywhere been found possible to make a marketable briquette of bituminous or anthracite coal dust without the use of a matrix or binder to hold the pulverized material together. The percentage of binder required varies with the composition of the coal, from two to ten per cent, and, as has been previously explained, the pitch of coal tar, which is the binder ordinarily used, costs in Germany from ten to twelve dollars per ton, and at that price its use for briquetting purposes in a higher proportion than six to seven per cent is commercially unprofitable.

The ingenuity of inventors in European countries has of late years been directed especially toward improvements in binders and the discovery of materials other than coal tar which would answer the same purpose. One hears or reads from time to time of a new matrix which will cheapen the cost of coal briquettes, facilitate their manufacture or improve their quality; but these accounts are founded rather on the claims of inventors and promoters than on demonstrated industrial results. One of the latest and most interesting of these discoveries is reported from England, where it is stated that Messrs. William Johnson & Sons, makers of briquette machinery at Leeds, have in use a binder produced by an inventor named Cory, which, when used with Cardiff coal, produces industrial briquettes which are practically smokeless. This fuel is under trial by the British Admiralty, and a photograph has been published showing two war vessels steaming side by side—one burning raw Cardiff coal, with volumes of dense smoke trailing from its chimneys, the other using Cardiff briquettes made by the Cory process, leaving an aerial wake as clear as though the furnaces were stoked with charcoal or anthracite. So far as appear, this process does not claim to use the inferior waste of mines or coalyards, but takes good coal, condenses and renders it compact to transport and, to all practical purposes, smokeless. It is further stated that a machine costing $4,500 will produce fifty tons of briquettes per day, and plans are matured by which one or more of them will be exhibited in operation during the coming exposition at St. Louis.

THE ELEVENTH ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

A LARGE DEVELOPMENT AS SHOWN BY CAREFULLY COMPILED BUSINESS STATISTICS.

The eleventh annual report of the General Electric Company for the year ending January 31, 1903, has been issued.

The profits of the company for the past year (including a profit of $973,649.74 upon securities sold), after deducting all general and miscellaneous expenses, and allowances for depreciation, losses and writing off $386,875.93 from patent account, and $1,908,324.11 from factory plants and machinery, were $10,277,169.16; less interest on debentures $44,331.17—$10,232,837.99.

Further deductions from patent account for expenditures incurred chiefly in acquiring the patents of the Sprague Electric Company, $1,613,879.82—$8,618,958.17.

The amount of surplus at the end of last fiscal year was $15,287,140.65—$23,906,098.82.

Paid in dividends during the year, $2,677,263.50—$21,228,835.32.

Stock issued in restoring percentage of reduction made in 1898, $16,746,133.33.

Surplus, January 31, 1903, $4,482,701.99.

The total sales (amount billed to customers) during the past year were $36,685,598.

The orders received included: Generators and rotary converters, capacity over 590,000 kilowatts; railway motors, more than 11,000, capacity over 490,000 horse-power; transformers, capacity over 475,000 kilowatts; stationary motors, more than 16,000; arc lamps, more than 80,000.

Water-power enterprises have been equipped with 428,269 horse-power in General Electric generators. There are now also in operation twenty-four plants equipped with 41,820 horse-power in General Electric generators, which plants are operated partly by steam and partly by water power.

Expenditures aggregating about $2,500,000, exclusive of the cost of patterns, small tools, etc., have been made during the year for real estate, extensions to existing buildings and the erection of new ones, and for additional machinery—all required to take care of the increased business.

The following table shows approximately the increase in floor space and in the number of employés during the past five years:

	Factory Floor Space in Square Feet.	Factory Employés.
1899	1,800,000	8,000
1900	2,000,000	11,000
1901	2,300,000	12,000
1902	2,500,000	15,000
1903	3,000,000	18,000

Engineering work of the past year has been largely devoted to the development of established lines of apparatus. The number and variety of useful applications of electrical machinery have kept pace with the increased volume of business. Standard apparatus has been improved in quality and efficiency, and considerable special apparatus has been designed and manufactured to meet novel conditions.

There has been a large increase in the equipment of industrial establishments with electric motors, the advantages of the electric motor drive being more clearly recognized with the increase in the number of its applications. Business in such applications showed an increase of forty per cent during the past year. This increased use of the electric motor has been especially notable in the case of cotton mills, steel plants, cement works, oil refineries and machine works.

The distance to which electricity has been delivered has been largely increased and many new long-distance plants have been installed, using pressures of from 60,000 to 80,000 volts and delivering power at distances of from 50 to 150 miles. A notable instance is that of the transmission of 6,000 horse-power from the falls of the Cauvery River, ninety miles, to the Kolar gold fields in Mysore, India. The entire transmitting and receiving machinery of this plant, as well as the transmission line, was constructed by the General Electric Company.

Six of the eleven 5,000-horse-power generators for the new power station at Niagara Falls have been put in operation and are highly successful.

After months of investigation, competitive tests and trials, the Interborough Rapid Transit Company awarded to the General Electric Company the contract for all of the control equipment of its cars.

The report also states: "By the purchase of the Sprague patents we have come into possession of the only fundamental and detailed patents, outside of those already owned by our company, covering a successful and satisfactory form of multiple unit control. This system, now known as the Sprague General Electric system, is in successful operation on many roads."

The following is a list of roads which have been equipped with or have contracted for this system of control:

NAME.	LOCATION.	NO. OF CARS.
Manhattan Railway Co.	New York City	900
Aurora, Elgin & Chicago Railway	Chicago, Ill.	38
Houghton County Railway Co.	Houghton, Mich	8
Boston & Maine Railway Co.	(Concord & Manchester Division) N.H.	12
Chicago, Burlington & Quincy Railway	(Deadwood & L. C. Division)	3
Canton & Akron Railway	Canton, Ohio	10
Columbus, Buckeye L. & Newark Railway	Columbus, Ohio	9
Columbus, Delaware & Marion Railway	Columbus, Ohio	14
Columbus, London & Springfield Railway	Columbus, Ohio	11
Detroit & Chicago Railway	Detroit, Mich	10
Denver & Northwestern Railway	Denver, Col.	5
International Railway	Buffalo, N. Y.	36
Central London Railway	London, England	64
Great Northern & City Railway	London, England	35
Chemin de Fer de L'Ouest, France	France	2
Mediterranean Railway Co.	(Gallarate Division)	2
Lake Shore Electric Railway	Toledo, Ohio	28
Northwestern Elevated Railway	Chicago, Ill.	67
Seattle & Tacoma Interurban Railway	Seattle, Wash.	10
Fonda, Johnstown & Gloversville Railway	Gloversville, N. Y.	8
Schenectady Railway Co.	Schenectady, N. Y.	22
Athens & Piraeus Railway	Greece	1
Prussian Government Railway	(Anhalt Suburban Division)	19
Interborough Rapid Transit Co.	New York	340
Boston & Worcester Electric Railway	Worcester, Mass.	36
Milwaukee Electric Railway Co.	Milwaukee, Wis	25
Baltimore & Ohio Railroad Co.	Baltimore, Md.	4
South Side Elevated Railway Co.	Chicago, Ill.	150
Boston Elevated Railway Co.	Boston, Mass.	156
Wilkesbarre & Hazleton Railway	Wilkesbarre, Pa.	6
North Eastern Railway	England	50
Total number of roads		31
Total number of cars		2,081

It is interesting to note that the size and voltage of generators and transformers used in connection with long-distance transmission have greatly increased. There are in successful operation transformers of over 50,000 volts, and orders have been secured for others to be used at 80,000 volts.

The design of mining locomotives has been so satisfactory as to result in greatly increased business. It is interesting to note that one coal company now operates some fifty of these locomotives over 200 miles of track, mostly underground.

The officers of the company are as follows:

C. A. Coffin, president; Eugene Griffin, first vice-president; E. W. Rice, Jr., third vice-president; Hinsdill Parson, fourth vice-president; W. F. Westover, secretary; Henry W. Darling, treasurer and assistant secretary; Anson W. Burchard, comptroller; I. S. Keeler, second assistant secretary; H. P. Schuyler, assistant treasurer; Edward Clark, general auditor.

W. J. Clark, manager foreign department; J. R. McKee, manager power and mining department; J. R. Lovejoy, manager lighting, railway and supply departments.

Henry W. Darling, collections; H. P. Schuyler, credits; Edward Clark, accounting.

G. E. Emmons, manager Schenectady Works, Schenectady, N. Y.; W. C. Fish, manager Lynn Works, Lynn, Mass.; Geo. F. Morrison, manager Harrison Works, Harrison, N. J.

Hinsdill Parson, counsel; Albert G. Davis, counsel; Charles Neave, counsel.

Board of directors are as follows: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., Frederick P. Fish, George P. Gardner, Eugene Griffin, Henry L. Higginson, J. Pierpont Morgan, J. P. Ord, Robert Treat Paine, 2d, George Foster Peabody, Charles Steele.

CONSOLIDATED BALANCE SHEET OF JAN. 31, 1903.

ASSETS.		
Cash		$ 3,632,556 17
Stocks and bonds	$12,682,214 63	
Real estate (other than factory plants)	431,455 98	
Notes and accounts receivable	12,816,607 04	
Work in progress	1,769,456 49	
	$27,699,734 14	
MERCHANDISE INVENTORIES.		
At factories	$10,297,594 99	
At general and local offices	1,165,921 00	
Consignments	97,700 73	
	11,561,216 72	
		39,260,950 86
Factory plants	$5,000,000 00	
Patents, franchises and good-will	2,000,000 00	
		7,000,000 00
		$49,893,507 03
LIABILITIES.		
Five per cent gold coupon debentures	$ 99,000 00	
Three and one-half per cent gold coupon debentures	2,049,400 00	
Accrued interest on debentures	825 00	
Accounts payable	1,378,960 42	
Unclaimed dividends	1,886 29	
		$ 3,530,071 71
Capital stock		41,880,733 33
Surplus		4,482,701 99
		$49,893,507 03

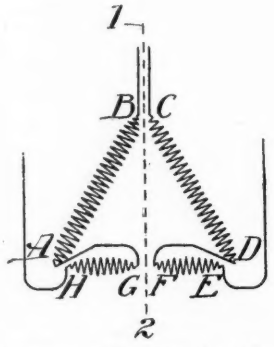
CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JAN. 31, 1903.

EXPENSES.		
Cost of sales		$28,844,881 40
Interest on debentures		44,331 17
Profit for the current year		10,232,837 99
		$39,122,050 56
Deduction from patent account for expenditures incurred chiefly in acquiring the patents of the Sprague Electric Co.		$1,613,879 82
Dividends paid in cash		2,677,263 50
Stock issued in restoring percentage of reduction made in 1898		16,746,133 33
Surplus at January 31, 1903, carried forward to next year		4,482,701 99
		$25,519,978 64
EARNINGS.		
Sales	$36,685,598 00	
Royalties and sundry profits	814,958 66	
		$37,500,556 66
Dividends and interest received on stocks and bonds owned	$393,961 49	
Interest and discount	253,882 67	
		647,844 16
Profit on sales of stocks and bonds		973,649 74
		$39,122,050 56
Surplus brought over from last year		$15,287,140 65
Profit for the year ending January 31, 1903		10,232,837 99
		$25,519,978 64

Electrical Patents.

The National Battery Company, of Cleveland, Ohio, and Jersey City, N. J., has purchased a patent on a storage battery invented by Mr. Elmer A. Sperry, of Cleveland, Ohio. This invention relates to the manufacture of hard, positive plates for storage batteries; and it has for its object to increase the hardness and density of such plates without interfering with the proper action of the electrolyte on the active material. In the manufacture of such plates or elements, as usually carried on heretofore, the active material, or the composition of which the active material is the chief constituent, is moistened with a liquid to form a plastic mass, which can be applied to the grid and pressed thereon under high pressure. In accordance with the present invention finely divided metallic lead is employed as the active material and a particular menstruum is employed for the purpose of moistening the active material to form the plastic mass, the combination of such menstruum with the metallic lead having the effect of rendering the positive plates denser, and therefore better able to withstand the disintegrating influences to which they are subjected. The menstruum consists of a neutral liquid, preferably distilled water, to which is added ammonium hydroxide. The precise proportions of the liquid are not important; but it is found that one part of the hydroxide to two parts or three parts of water gives satisfactory results. The dry powdered substance which forms the body of the element and which may by preference be a composition of metallic lead and ammonium sulphate is thoroughly mixed with the menstruum above described, as by violently agitating the dry powder and the liquid in a suitable vessel, and the plastic mass thus prepared is applied to the grid, which is then dried out under very high pressure. The element formed as above described is dense and resists the disintegrating influences to which such elements are subjected.

Messrs. John F. Kelly and Cummings C. Chesney, of Pittsfield, Mass., have invented a novel alternating-current apparatus and have assigned the patent obtained thereon to the Stanley Electric Manufacturing Company, also of Pittsfield. The invention has for its object the production of alternating currents of definite phase displacements from electromotive forces of different phase displacements by the use of main and auxiliary generating circuits. It is applicable to both alternators and secondary generators or transformers. By this invention any generating circuits, such as those of a three-phase generator or the three secondaries of three transformers supplied by three-phase currents, can be combined to produce two currents of ninety degrees phase difference, or the circuits of a two-phase generator or the two secondaries of two transformers supplied with two-phase currents can be combined to produce three-phase currents. The same fundamental invention is involved in producing both these results. The accompanying diagrammatic view illustrates one example of the invention. AB and CD represent two armature circuits situated with relation to one another, the same as two adjoining circuits of any delta-wound generator. EF and GH may be regarded as two parts of the third circuit of the delta-wound generator. It is to be noted that all these parts are symmetrical relatively to a vertical line 1 2. The

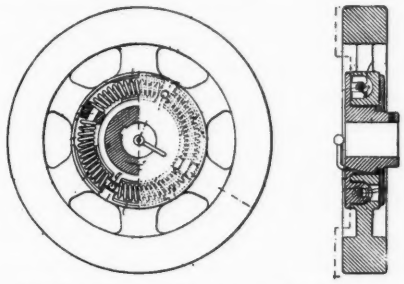


ALTERNATING-CURRENT APPARATUS.

electromotive force in the circuits AB and CD and the two-part circuit EF GH are all displaced from one another by 120 degrees. Now the inventors have discovered that they can by applying to AB a reversed portion GH of the third circuit and to CD an equal reversed portion thereof EF, so as to combine the electromotive forces of AB with those of GH reversed, and the electromotive forces of CD with those of EF reversed, they can produce resultant electromotive forces which shall be displaced by ninety degrees and produce an efficient machine for the generation of two-phase currents. In order to produce this result, they make the auxiliary generating circuits GH and EF each equal to 0.366 of one of the main generator circuits AB and CD and connect the inner end of GH and the inner end of EF to the ends of the main generator circuits AB and CD, respectively, as shown, and the outer ends of GH and EF to the line conductors 3 4. The two circuits AB and CD are either connected to their respective line conductors 5 5′ or joined together so as to have the common return ordinarily used in two-phase systems.

The General Electric Company, of New York, controls a patent recently issued on means for preventing fluctuations in rotary motors, invented by Mr. James J. Wood, of Fort Wayne, Ind. Mr. Wood thus describes his invention: The object of this invention is to prevent or reduce fluctuations occurring in rotary motor devices, by which term I mean to include prime-movers—such as steam engines, turbines, impact-wheels, or the like—and also secondary motor devices—such, for example, as dynamoelectric generators, electric motors, rotary converters, and the like. My invention finds its most important application to synchronous alternating dynamoelectric machines, by which term I mean to include alternating generators, alternating synchronous motors, and rotary converters. My invention is applicable wherever in such a rotary motor fluctuations are liable to occur from a uniform rotation, by reason either of variations in the propulsive energy or variations in the work or load, which variations recur at frequent intervals, so that they tend to produce alternate accelerations and retardations of the motor, such as are known in the art as hunting or pumping. To make my invention fully apparent, I will proceed to describe the same in its application to a synchronous alternating motor. In operating such motors it is well known that when the dynamo or generator fluctuates in speed in different parts of a revolution (as occurs when the generator is driven by an engine the propulsive thrust of which varies at different periods of each revolution) the motor tends to hunt or pump; that is, its armature runs sometimes a little faster and sometimes a little slower than the generator, with the result of causing a beating sound in the motor and of disturbing the circuit, as will be indicated hereinafter. Such hunting or beating action is usually indicative of some irregularity in the circuit feeding the motor. This irregularity may consist of variations either in speed or in electromotive force. The variation in speed of the generator tends to cause a corresponding variation in the speed of a synchronous motor. The motor can not, however, assume instantly the speed required by the new speed of the generator. When the speed of the generator increases, the motor-armature begins to increase in speed; but by reason of its lagging the motor receives an increased

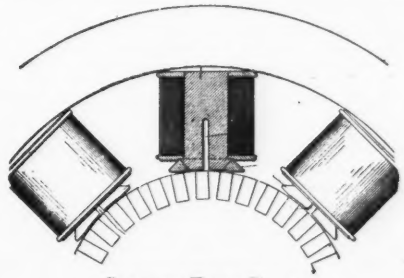
current, because its armature is not in normal position for the new frequency and because additional current is required for supplying the energy necessary for increasing its speed. This additional current produces a difference of magnetism of the field, which must again be altered when the generator speed decreases below the average. The motor is therefore undergoing a slight variation in speed, which seeks to approximate to, but does not exactly correspond with, that of the generator. This pumping or rocking or hunting effect, however, will almost entirely disappear when even a small load is put on the motor. It has heretofore been the custom to weaken the field of a synchronous motor when it was found



FOR PREVENTING FLUCTUATION IN ROTARY MOTORS.

to pump. The effect of this is to lower the electromotive force of the motor, thereby putting an artificial load on the armature, which, however, while it reduces the pumping, has the disadvantage of reducing the electromotive force of the generator and of upsetting the line. To overcome this defect and avoid interference with the line, it has been proposed to apply a flywheel to the shaft of the motor through the medium of a yielding connection comprising a spring or springs under tensile strain. It has been found in practice, however, that this construction is not an efficient one, as the springs and connections quickly break in use. By my invention I am to provide an improved construction of such a device, wherein this defect is avoided. I hence provide a spring connection between the flywheel and shaft, wherein the spring or springs act by compression to produce the desired effect, and I provide stops for limiting the relative movement of the flywheel and motor-shaft, so that the degree of compression which may be applied to the springs is limited, and provide means for guiding the springs concentrically with the axis of the wheel. The effect of such flywheel is to prevent the objectionable pumping action referred to. If the generator speed suddenly increases, the armature tends to accelerate correspondingly its speed; but the flywheel lags behind, thereby putting a slight load on the motor, and then when the generator slows down the motor-armature tends to run slower, while the flywheel, tending to run at a uniform speed, catches up with the motor-shaft and forces it ahead or resists its tendency to slow down, thereby again putting a slight load on the motor. I have already stated that putting a slight load on a synchronous motor extinguishes the pumping effect, this being equally true whether it is electrical, by weakening the field and taking extra current, or is mechanical, by throwing some additional work upon the motor. Such yieldingly connected flywheel is of the latter order and has the effect of causing the motor to run without any pumping. Inasmuch as the load imposed by the flywheel is felt only at the instant when the variation in speed occurs, its effect in correcting the pumping is accompanied by less loss of energy than with a load which imposes a continuous drag on the motor.

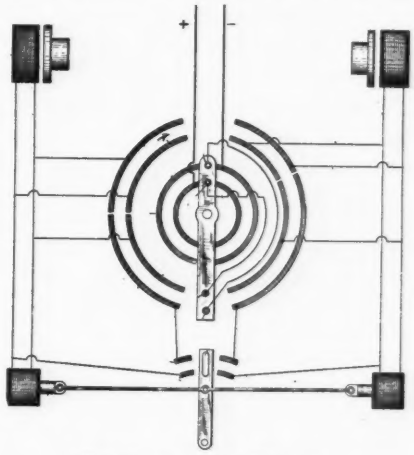
The General Electric Company has purchased a patent granted to Mr. Alexander Churchward, of Chicago, Ill., on a pole-shoe for dynamoelectric machines. This invention relates to dynamo-electric machines; and its object is to ensure a more even distribution of the lines of force induced by the field-magnets, and thus prevent sparking at the brushes. It is well known that ordinarily the rotation of the armature tends to crowd the lines of force in the field toward that side of the field-pole from which the armature is moving, a result which



SLOTTED FIELD-POLES.

interferes with the efficiency of the machine. It is customary in some machines to overcome this objection to a certain degree by slotting the field-magnet core on a plane transverse to the line of movement of the armature; but such machines generally have also a pole-shoe in order that as many lines of force as possible may be utilized. The effect of the slot is reduced almost to a minimum by the shoe, because the latter completely encircles the end of the magnet-core or pole-piece, so that there is a metallic path for the magnetic flux from one side of the pole to the other. Mr. Churchward employs the usual pole-pieces having slots located radially to the armature. Instead of employing shoes that completely encircle the pole-pieces, he provides U-shaped parts that terminate at the slots, so that the continuity of the shoes is interrupted at these points and they do not magnetically bridge the slots.

In certain classes of machinery employing electromagnetic clutches, and especially in cases where a pair of the clutches is employed for purposes of reversal of direction of motion, serious diffi-



ELECTROMAGNETIC CLUTCH.

culties arise from the indisposition of the clutches to release promptly when the energizing current is cut off, or, in other words, from the time lag of demagnetization. In metal-planing machines, for instance, where the actuating motion is transmitted through the medium of alternating acting electromagnetic clutches, the time lag of demagnetization of the clutches is often so great as to prevent the possibility of reversal within short lengths of table travel or of uniformity of reversals regardless of the length of travel. In such machines the reversing-tumbler, actuated automatically by the table-dogs, puts the current first to one clutch and then to the other, the circuit being open for the idle clutch. Mr. Adolph L. De Leeuw, of Hamilton, Ohio, has patented an improved controlling-switch system which overcomes these difficulties. This patent has been assigned to the Niles Tool Works Company, also of Hamilton, Ohio. The plan followed is practically the same as that above described, but just before opening the circuit to cause the deenergization of a given clutch, the polarity of the current going to that clutch is reversed for a period sufficient to demagnetize the clutch, but not sufficient to remagnetize it by the influence of the reversed current. As a result, quick action is obtained on the part of the clutches and the system is made peculiarly adaptable for short work.

Reviews of Current Engineering and Scientific Literature.

Radium Emission.

In this communication Sir Oliver Lodge discusses the recently discovered action of radium in continually emitting heat. It is worth noting, that this action appears to be connected with and is probably an immediate consequence of the remarkable observation by Rutherford that radium emits massive, positively charged particles, which are probably atoms with a velocity comparable to one-tenth of the speed of heat. The emission of a million heavy atoms per second, which is a small quantity, barely weighable, being about the twentieth part of a milligramme per century, with a speed equal to one-tenth that of light, would represent an amount of energy equal to 1,000 ergs per second, which would be enough to melt a milligramme of ice every hour. Inasmuch as these atoms are not at all of the penetrating kind, but are easily stopped by obstacles, they would most of them be stopped by a small thickness of air, and their energy would be thus chiefly expended in the immediate proximity of the source, which source would thereby tend to be kept warm. By enclosing a bit of radium in a small chamber formed of massively obstructing, non-conducting walls, it could be made quite hot, provided always that the assumed necessary stimulus or external supply of molecular energy can get at it uninterruptedly. If, in the open, the rate of escape of heat were such that on the average it accumulated for one minute before escaping, the temperature of source and ambient air, with an assumed heat capacity equal to that of one milligramme of water, would amount to 1.5 degrees centigrade.—*Abstracted from Nature (London), April 2.*

The South Lancashire, England, Tramway Network.

The South Lancashire Tramways Company has taken over the control of a number of small tramway systems between Liverpool, Manchester and Bolton. The systems thus to be welded into a whole will have a mileage of 550, and will serve a population of about 5,000,000. Both passenger and freight service will be given and a traffic agreement has been made with the Great Central Railway. The track will be laid with four-foot, eight and one-half-inch gauge; girder rails six inches deep, ninety pounds per yard, and forty-five feet in length, will be used. A longitudinal sleeper will be laid under the rails, and there will be a six-inch foundation of Portland cement and concrete throughout the entire width of the track. The generating station is centrally situated at Howe Bridge. The engine room is sixty feet wide and 120 feet long. There are two 500-kilowatt, 7,500-volt, two-phase alternators, one 500-kilowatt railway generator, and a 250-kilowatt booster. The battery plant has a capacity of 980 amperes at one hour discharge, or 1,400 amperes for shorter periods. The generators are direct-connected, and the exciters are driven from the flywheel by means of ropes. The substation plants comprise a 150-kilowatt, high-tension motor-generator set, the two machines being mounted on one bed-plate, and rigidly coupled together. This set works in conjunction with a storage battery, and this equalizes the load upon the power station. The high-tension cables are drawn into stoneware pipes, and the low-tension feeders are mostly laid on the solid system in troughs. The high-tension feeders have three conductors, one being the common return for the two phases. The two conductors are arranged as a twin cable, and the return encircles the whole as an outer conductor, and is earthed at the central station. The system of overhead construction is mostly that of side poles and brackets. Guard wires of galvanized steel are used, and there are switch pillars every half mile.—*Abstracted from the Electrical Times (London), April 9.*

The Training of Engineers.

At a recent meeting of the British Institution of Naval Architects, Professor W. E. Dalby read a paper on "The Training of Engineers in the United States," which described the methods now used in several technical schools in this country. A lively discussion resulted, showing the interest that the British manufacturers have in this subject. Mr. Yarrow, of Yarrow & Company, spoke of the difference in the apprenticeship systems of the two countries. In England, poor men's sons were, in many cases, shut out from thorough practical training on account of the premium demanded. Although the most valuable part of the engineer's training is gained through practical work, in the present day both scientific and practical knowledge forms his mental equipment. While many great men have sprung from the working classes, they have succeeded rather in spite of their lack of scientific training. A man's success at college did not indicate that he would make a good engineer. Too much book-learning prevented the proper training and development of the powers of thought and observation. Practical work is necessary that the student may assimilate his knowledge. There are three methods followed to-day—a technical training followed by practical work, or the reverse; or the method now adopted in Scotland. Here the student devotes six months of the year to his school, and six months to the workshop. The system has the advantage of enabling a young man not suited for the profession to be made aware of the fact as soon as possible. It also gives the instructors an opportunity for private work, which is necessary to keep them in touch with the latest practice. Mr. Archibald Denny did not believe that a young man could work during the daytime and study effectively in the evenings. Mr. Hans Renold thought that more encouragement should be given to the schools from the employers, and the whole question was one more for them than for the educationalists. Technical education is necessary to-day, and although many men made their mark without technical education sixty years ago, conditions to-day are far different. Dr. Garnett stated that the College of Science, at Newcastle, had started a three-days'-school and three-days'-work system for mining students. A system similar to that described by Mr. Yarrow had been adopted at Bristol with a great deal of success. Professor Lambert thought that the supremacy of the engineering industry rested on technical education, and that it would almost appear as if the civilized world would some day be peopled by engineers. One thing that was needed was a proper supply of teachers. He suggested a technical school for teachers, so that they might not have to pick up the essential part of their profession at hazard. Mr. Stromeyer said that every effort should be made to increase the salary of those engaged in teaching, so as to secure men acquainted with both the scientific and practical sides of the subject. Under the present condition, if a lecturer or demonstrator were worth anything at all, he could obtain ten times as much salary anywhere else as he could command in a college. A matter that is es-

sential for the preparation of an engineer is that he should have experience with men at an early age, and he pointed out that the German compulsory military system supplied, in a way, this training. Mr. H. G. Morse, president of the New York Shipbuilding Company, thought that the college student should start as low down as any one, but he would learn more quickly and get beyond the less highly educated men. His own company was filling positions in the yard from the draughting room, and although these men received twice the pay of men who could do the work, better results have been obtained. Professor Capper thought that it was difficult for a man to take up college work after starting in the works. If he were a good man he would be offered inducements to stay at work which it would be hard to resist. He thought that the supply of technical instructors was a subject that needed immediate attention. The training of technical teachers he could only describe as horrible. They should remain in touch with the developments of engineering, and keep themselves efficient; but the pay was quite inadequate, and time was not given for research. With too low pay, and no time for research, the tendency was for them to become mere drudges, and it was to their credit that they should maintain an interest in the work under the circumstances.—*Abstracted from Engineering (London), April* 10.

Notes on the Coherer.

The theory of the coherer is but little understood, as experimental study is difficult and unsatisfactory. In this article Mr. A. H. Taylor gives the results of some extended investigations upon the so-called single-contact coherer. It was found that when properly adjusted, the simplest form of coherer was extremely sensitive. Work with it could be carried on only at night, as the instrument was affected by variations in the neighboring electrical circuits, by shocks and jars, and by noises. Work was first attempted with a spherometer coherer, but it was found that this instrument did not allow of sufficiently close adjustment. A special instrument was then designed, which was formed of two bars of soft steel, one hinging upon a knife edge which rested in the groove of the second. The first could be rocked in this groove by a micrometer screw attached to the other end of the bar, near the knife edge, and insulated from the movable bar was the coherer rod. This was tipped with nickel and was opposed to a nickel terminal upon the other bar. By moving the micrometer screw, adjustments as small as one seventy-thousandth of an inch could be made. With such small movements there was no need of using polished or specially shaped terminals, and the nickel was prepared by simply scraping the surface with a clean knife. Measurements were made by adjusting the contact and then varying the current flowing through this contact, measuring at the same time the fall of potential across it. The most sensitive adjustment for any value of current was found by adjusting the contacts until the current flowing through the coherer was about one-third of its value when short-circuited. Attempts to shield the coherer from disturbances were not successful. A large number of curves showing the results of this work are given. In general, two types are noticed: Those in which the voltage remains fairly constant for a considerable variation in current, and those in which it rises gradually with a slight increase in the current. Curves showing a constant potential are obtained only under the most favorable conditions, with clean contacts and the absence of outside disturbances. Under these conditions the coherer is the most sensitive. The results lead to the conclusion that the phenomena may be divided into three classes, corresponding to three stages in the condition of the contacts. First, there is a feeble leakage of current across the contacts, due to vapor conductivity; second, the potential rises high enough to cause conduction by metallic ions; and, third, when near it acts as a metallic conductor. —*Abstracted from the Physical Review (New York), April.*

Experiments with a High-Tension Fuse.

An interesting article by Dr. C. C. Gerrard describes some tests carried out with a high-tension Ferranti fuse. These fuses are enclosed in a porcelain pot eighteen and one-half inches high, which is divided down the middle by a partition. Over this partition hangs a porcelain saddle, with projecting cross-pieces which divide the whole pot into eight compartments. There is no lid, nor is there any gear above the fuse. The fuse consists of four wires, in parallel, attached to the bottom on one side of the partition and to a drum on the other side, against the tension of steel spiral springs fixed within the drum. The pot is filled with oil. This fuse is designed for 11,000 volts and large power. In these experiments they were short-circuited across one phase of a 5,000-horse-power, 11,000-volt, two-phase generator. Various sizes of copper wire were used, the maximum carrying capacity being for 250 amperes. Upon closing the circuit a loud report was heard, and a cloud of smoke shot up into the air. The resin oil used was found to be very little carbonized. No deposit of carbon was made on the outside of the pot, and but little on the dividing saddle. At the instant of breaking, a bright flash on top of the oil was noticed, but the current was broken instantaneously. Practically no oil was spilled, but just a little was projected out in the form of small drops. On examining the pot after each fuse had been blown, it could be seen that the flash had been confined to one of the four parallel fuses, the wires on the other three being broken cleanly in the middle, as though they had been cut with a knife, though those of the remaining one had totally disappeared. This action is advantageous, since the arc formed is proportional to the amount of metal vaporized. The flash did not always occur at the same point. The tests were repeated a number of times, with the same result and without damage to the porcelain pot. They were severe, and show that a multiple oil-break fuse is a reliable means for protection for cables up to a voltage as great as that used in these tests.—*Abstracted from the Electrical Review (London), April* 10.

Coherence.

In a communication to the *Electrical Review* (London), a theory is advanced in explanation of the behavior of the Branly coherer. When a rod of iron is traversed by magnetic lines of force, the rod will increase slightly in size in a direction parallel to the lines of force, and when withdrawn from the magnetic field it will again assume its normal condition. It is known that a simple coherer, consisting of two electrodes in contact with metal filings, will cohere on being brought into a magnetic field. When placed in a magnetic field, the filings arrange themselves parallel to the lines of force, and each increases slightly in length while under the influence of the magnetic lines. This action is sufficient to bring the particles into closer contact, converting the coherer into a comparatively good conductor. When removed from the field, the particles regain their original size, but retain their parallel position, and a jar is necessary to cause complete decoherence; but the author believes that there is a slight decoherence without any mechanical aid.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Automatic Circuit-Breaker for Charging Automobile Storage Batteries.

A great many users of electric motor vehicles have found it difficult to regulate the charging of their storage batteries, and this is due sometimes to the lack of knowledge on their own part, and often to the inattention of those whose duty it should be to properly prepare the cells for power service. The need of an automatic device which shall be efficient to the degree that it will compensate for either unskillfulness or lack of care has long been evident. The advent of a practical circuit-breaker which shall make impossible injury to the battery while charging will not fail to prove a valuable factor in furthering the cause of an already popular but much abused source of energy.

The accompanying illustration shows a new circuit-breaker which has been designed for this service after careful experimentation along such lines as would produce an efficient and trustworthy apparatus.

The object of this circuit-breaker is to ensure against overcharging of a storage battery. The principle of operation is the automatic opening of the circuit when the charging voltage across the battery terminals rises to a predetermined point, dependent upon the nature of the battery and its voltage or number of cells.

For convenient adjustment of point of cutout, the device is graduated in volts and calibrated at working temperature of coil. There are two varieties, differing only in the coils, which interchange with each other. In one the coil is wound in two parts, which, when connected in series, adapts the circuit-breaker for use in charging forty-cell batteries, and, in parallel, for use with twenty-cell batteries. The other is a single coil which adapts the circuit-breaker for use with ten-cell batteries. By means of the adjustment, the first coil, with the two sections in series, is made to include the range of requirements from forty to forty-four cells, inclusive; with the two sections in parallel, from twenty to twenty-two cells, inclusive; the second coil from ten to twelve cells, inclusive.

When cool the release will take place at a lower voltage than indicated by the graduations, so that if charging circuit has been unused long enough to allow the circuit-breaker coil to cool off, it should be temporarily adjusted at a high enough cutout voltage to ensure closed circuit for about twenty minutes, by which time the working temperature will have been attained and the coil can be permanently adjusted to open the breaker at the voltage predetermined for "full battery." If the circuit-breaker is in continuous or nearly continuous use this preliminary setting would, of course, be unnecessary, and resetting would be required only when a change takes place in the number of cells to be charged.

The time available for charging is

AUTOMATIC CIRCUIT-BREAKER FOR CHARGING AUTOMOBILE STORAGE BATTERIES.

usually enough to admit of the use of a relatively low rate, in which case the battery will be as full as can be desired before the circuit-breaker cuts out, but the use of the circuit-breaker also offers an especial advantage in those cases where the utmost rapidity is required in charging, for the device cuts out at the predetermined voltage whatsoever the charging rate, although at very high rates the predetermined voltage is attained when the battery is still somewhat short of "fulness." The opening of the circuit-breaker under these circumstances makes it possible to continue the charging at a lower rate for the remainder of the available time, or until the breaker cuts out again. In short, by the intelligent employment of this device it is possible to ensure that the battery is as full as the available time admits without requiring any special knowledge and without probability of risk of injury to battery.

For those lead-lead storage batteries now ordinarily available, the circuit-breaker should be set to release at about 2.55 volts per cell of battery to be charged. For example: For a 20-cell battery the circuit-breaker should be set at 51 volts; for 44 cells, 113 volts; for 40 cells, 102 volts. The temporary setting required when starting with perfectly cool coil should be roughly about ten volts higher in each case.

This gives a very satisfactory control of the charging of a battery without the necessity of experienced and skilled attention.

Experience has proved that over ninety per cent of the injury that has been suffered by storage batteries in the past has been brought about by ignorant or careless charging. An instrument which will keep constant watch of the voltage of a battery and whatsoever the probable charging rate will open the charging circuit at the point when violent gassing of the battery plates commences, is not only most convenient and desirable for private service, but has become an absolute necessity for commercial automobile storage battery operation.

This apparatus is manufactured by the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., which has for some time been making a specialty of electric automobile equipment.

Automatic Telephone Company's Success.

The Fall River Automatic Telephone Company, after charging off depreciation, has paid a quarterly dividend of one and one-quarter per cent, and has a surplus left. The number of subscribers' stations is over 1,000, and applications are being received daily. Eighteen months' operation of the automatic system, the company states, indicates that it improves with use, while no appreciable wear is shown. The expense, as well as the plant investment, shows a decided decrease per subscriber with growth of the exchange. The increased number of telephones in operation has shown no increase in number of troubles, and no necessity for additional help to take care of the system.

Electric Headlight Equipments for Locomotives.

Notwithstanding the remarkable advance which has been made in the design of locomotives within comparatively recent years, the equipment, with regard to the headlight, has hardly kept pace with the conditions as they exist. This has not been because of lack of the requisite apparatus, but rather from a too conservative adherence to established equipment. From time to time there have been developed electric headlights which have given more or less satisfaction, but have possessed features which the locomotive builder has found objectionable, as interfering with mechanical improvements which the locomotive designer regards as especially his own.

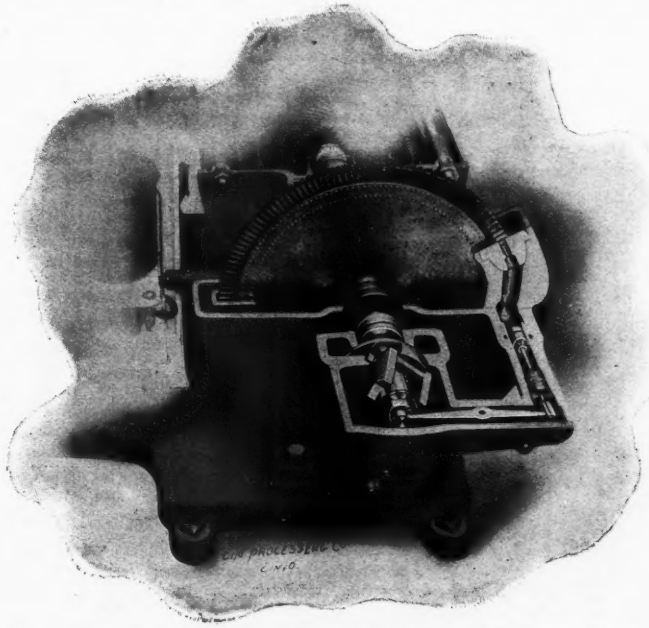


FIG. 1.—SECTION OF ENGINE HOUSING, GOVERNOR VALVE AND TURBINE.

The accompanying illustrations show some new views of the Edwards electric headlight. This has been described before in the ELECTRICAL REVIEW, and also illustrated. However, this apparatus possesses a number of points especially worthy of note, and the illustrations here shown will give a good idea of the operation of the equipment. The motive power for this equipment is produced by a steam turbine. This is shown very clearly in Figs. 1 and 2. Fig. 1 shows a section of the engine housing, the governor valve, lever valve, steam passage, and section of nozzle. The whole equipment is shown in Fig. 3. The equipment is mounted on a substantial bed-plate, which is secured to the housing of the engine. In some instances, by reason of a short smoke box extension or some other mechanical obstruction on the engine, it is desirable to place the turbine, engine and dynamo at some other location on the locomotive, setting the headlight case only on the smoke arch. To meet this requirement a special class of equipment is furnished. One of the unique and distinctive features of this equipment is the vertical beam of light which is reflected upward by arranging an auxiliary plane reflector at an angle of forty-five degrees outside of the goggle. This is shown in Fig. 3. The auxiliary reflector is placed in such a way as to intercept about forty per cent of the light issuing from the parabolic reflector, and direct it upward. The top of this shaft of light penetrates to a great height, and forms a constant signal, which may be seen even though an obscure curve may render invisible the direct light. In order that the objection to the dazzling glare of the arc light, when placed in the focus of a parabolic reflector, may be overcome, a translucent shade is furnished with this apparatus. This shade is located inside the goggle, operating in pockets provided for that purpose. This shade is manipulated by means of a small wire cable, by the engineer in the cab, and upon the approach of a locomotive, after having received the warning signal, the engineer is able to draw this shade across the light, so that the objection above referred to is obviated. With this arrangement the vertical beam is not shaded, but constantly projects its light upward.

Referring again to Fig. 1, the turbine consists of a metal wheel having a series of buckets upon its periphery, and upon which steam is allowed to impinge from a nozzle. The circular cast-iron housing, consisting of two parts which are bolted together in such a manner as to form an annular channel, in which the wheel revolves, forms the substantial body casting of the engine. The shaft at either end of the propeller-wheel is journaled in hardened and accurately ground ball-bearings. The propeller-wheel is wholly built up from rolled steel. The buckets are made from steel plate, die-formed and rigidly interlocked with steel plates which form the body of the wheel. The nozzle ports are formed in a substantial cylindrical bronze casting, and the jet port is so shaped that the steam is expended down to atmospheric pressure before it reaches the wheel buckets.

The engine governor is self-contained,

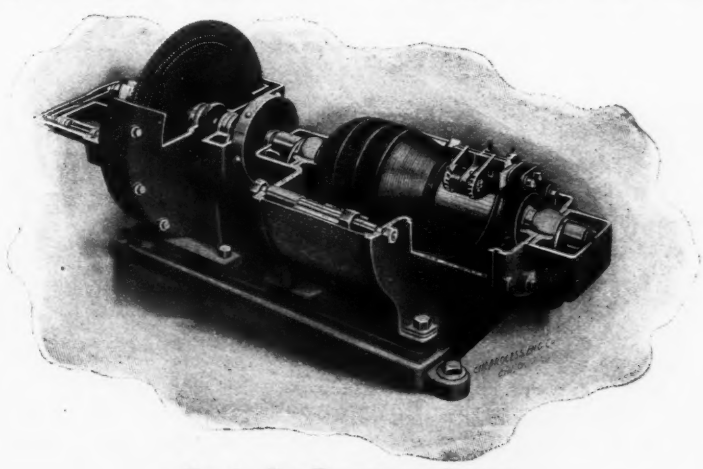


FIG. 2.—THE TURBINE AND DYNAMO.

and is threaded directly to the outer end of the propeller-wheel shaft. This is shown in Fig. 1. The centrifugal wings rock upon knife edges, their motion being retarded and controlled by a heavy helical steel spring. The pressure of the spring may be easily and quickly adjusted to change the engine speed. The motion

from this part of the governor is communicated to the valve stem through the medium of a simple lever. The valve is perfectly balanced, and operates in a bronze sleeve.

The dynamo is of peculiar construction, and is designed for this particular service. The machine is of four-pole type. The magnetic parts are wholly constructed from soft rolled steel laminations, built up to the proper dimensions, and firmly riveted together. The cores, having their pole-pieces integral, are key-locked in the yoke. The field energizing wire is differentially wound, the initial magnetization being derived from a shunt circuit. This is slightly counteracted by a half turn of heavy wire, which is connected in series with the external circuit, but through which the current circulates in opposition to the shunt coils. The effect of this combination of field circuits is to act as an automatic regulator, maintaining the current and electromotive force practically constant.

The armature is of the slotted type, the core being built up of thin soft-steel discs, thoroughly insulated. The winding is chordal, and two sets of brushes are used. The wire is insulated with woven cotton hose. The commutator is carefully made, the best grade of soft copper bars being used. Low-resistance carbon brushes are employed, and in operation have shown great length of life. The bearings are ample in size, and free lubrication is secured by means of loose rings hanging from the journal, and carrying oil from wells cored in the castings beneath the bearings, special provision being made to prevent the oil from reaching the wire of the field or armature. The dynamo produces an electromotive force at the arc of thirty to thirty-three volts, with a current of thirty to thirty-three amperes.

The arc lamp is simple in construction, and means is provided to perfectly adjust the arc and the focal point of the reflector, and maintain it in that position. All bearing surfaces are of ample proportion, and powerful magnets contribute to perfect the control of the carbon feed. The balance is such that a smooth and steady light is produced, regardless of the jar to which it is subjected when the locomotive is under high speed. The carbon holder is supported by a universal flexible connection, and the carbon is guided near its consuming end by a small bell crank weighted lever.

This apparatus is manufactured by the Edwards Railroad Electric Light Company, southeast corner of Sixth and Baymiller streets, Cincinnati, Ohio.

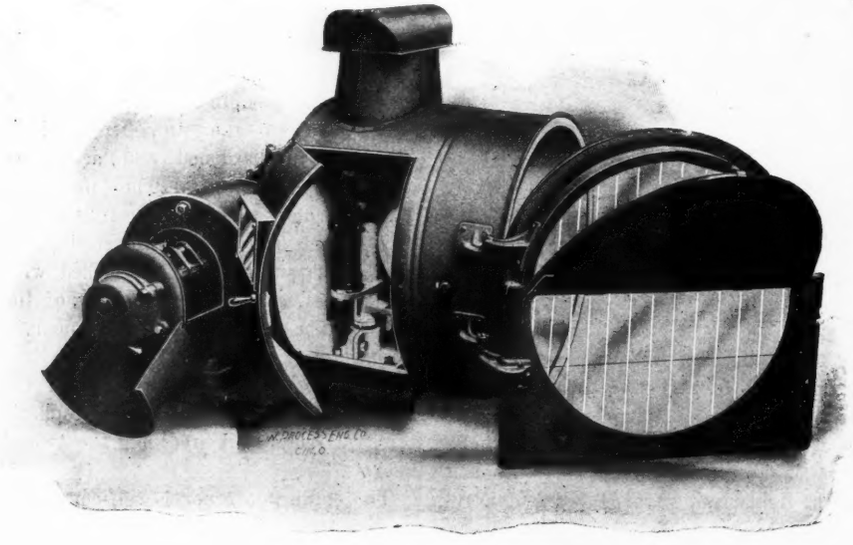


FIG. 3.—THE ASSEMBLED EQUIPMENT.

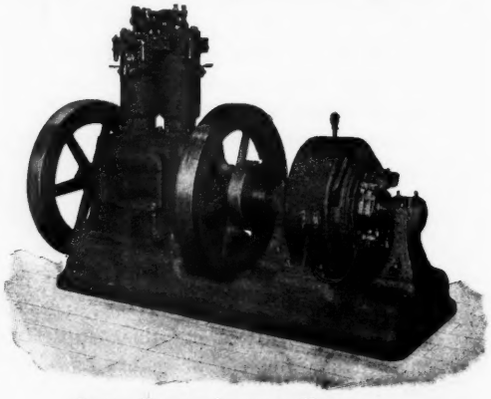
A Modern Bakery.

A novel application of electricity is a recent installation of the Sprague Electric Company's direct-current motors in the new bakery of the American Pastry and Manufacturing Company in East Fifteenth street, New York city. A large number of electric motors will be used to operate the machines for mixing dough for crackers, biscuits and pies. An ingenious apparatus has also been perfected for electrically operating the ovens, which is a new departure in this industry.

Direct-Connected Units for Isolated Lighting Plants and Automatic Charging Plants.

In the accompanying illustration is shown one of the units built by the Meriam-Abbott Company, of Cleveland, Ohio. This apparatus is adapted for isolated lighting plants, suited for country homes, apartment houses, and small factories. The company also makes this type of apparatus adapted for recharging batteries of electric automobiles, electric launches and other similar service. The plant starts automatically, it being unnecessary to turn the flywheel by hand. The engines are water cooled and self-oiling from the crank chamber. One of the features of this apparatus is the quiet running at all loads. The exhaust is noiseless, and jump spark ignition is employed. A flexible coupling is used between the engine and dynamo. Each plant is complete, ready for piping and wiring.

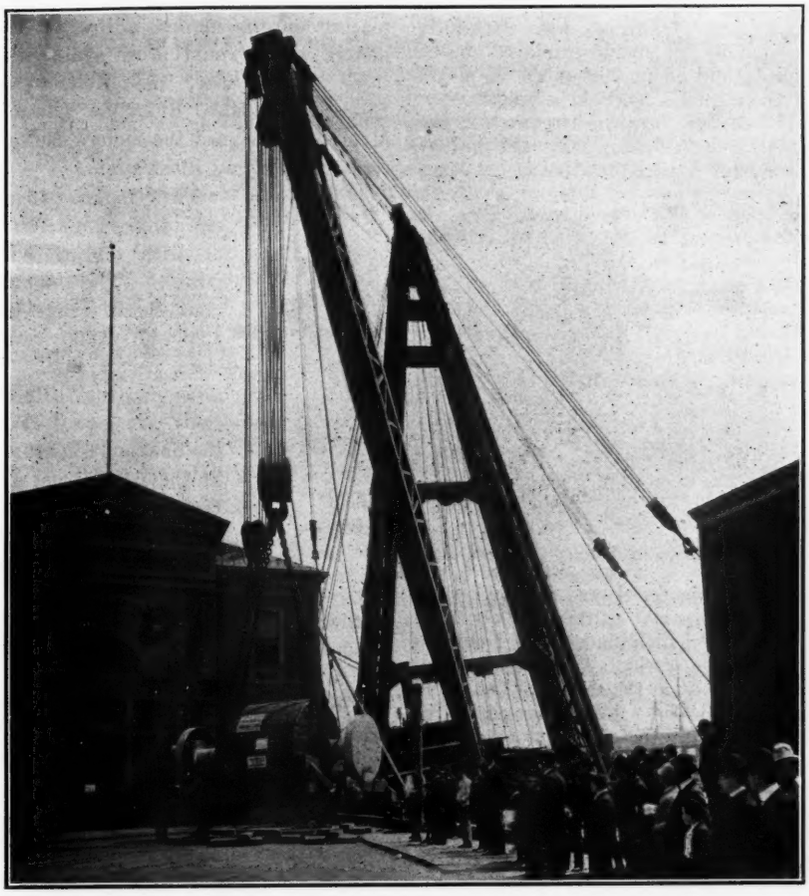
The engine, generator, controller and all the automatic safety devices are mounted on the same base. The machines are built for either gas or gasoline, and the dynamos are wound for any voltage. The plants can be arranged to automatically shut down when used as battery chargers, and the current can be regulated by hand to any desired amount within the capacity of the plant. With the machines used as battery chargers, an underload circuit-breaker is attached. This will at once break all electrical connections, and shut down the instant the current reverses. The same device shuts off the fuel and water supply. The engine is of the vertical type, the cylinders and pistons being of special construction, and the crank shaft is of solid forged material. The upper half of the bearings is genuine babbitt, and the lower half hard bronze. The cams are all hardened and ground, and drop-forged poppet valves are employed.



SMALL DIRECT-CURRENT UNITS.

Shipping an 850-Kilowatt Generator in One Piece.

The accompanying illustration shows the method of handling a large piece of apparatus under difficulties. Owing to the difficulty of the assembling and refitting of a large generator it has been necessary to move this in one piece.



LIGHTERING AN 850-KILOWATT GENERATOR, WEIGHING FIFTY-SIX TONS.

Rossiter, MacGovern & Company, New York city, purchased eight of these generators from the Metropolitan Street Railway Company some time ago. From time to time announcements have been made of the disposal of these in different parts of the country.

The accompanying illustration shows an 850-kilowatt generator weighing fifty-six tons being put on board a lighter at the dock at the foot of Twenty-seventh street, New York city.

Rossiter, MacGovern & Company has excellent facilities for handling apparatus of every description and not only buy and sell both new and second-hand machinery, but also has facilities for making all manner of repairs.

Decorations with Incandescent Lamps.

The accompanying illustration shows the remarkable extent to which a decoration with incandescent lamps may be carried. The use of small multicolored incandescent lamps has become very popular for this service. The engraving is a reproduction of a photograph of the decorations at a ball given by the Union Boat Club, of St. Louis, Mo.

The entire scheme of decoration consisted of southern smilax and poppies. A huge poppy with a bunch of lights inside hung down from the ceiling at one end of the room, and at the other end the initials "U. C." made of "Elblight" cable balances the effect of the large poppy.

SOUTHERN SMILAX AND POPPIES WITH INCANDESCENT LAMPS.

Throughout the room each lamp is surrounded by an artificial poppy, and the effect produced elicited universal admiration. The great flexibility of the twin conductors of the "Elblight" system, is made of practical service in this form of work. The St. Louis agent of the Elblight Company of America, Messrs. E. H. Abadie & Company, planned and executed the entire decoration.

The St. Louis Exposition Power Plant.

The 500-horse-power Duerr marine boiler, which was taken out of the battery of boilers of the German man-of-war Sachsen for exhibition at the Louisiana Purchase Exposition, raised steam for the first time on April 22, and operated the 300-horse-power, high-speed, automatic, tandem-compound engine supplied by the Buffalo Forge Company, of Buffalo, N. Y. This was the first work done by the pre-exposition power plant. Besides the Duerr boiler and the Buffalo engine there were placed in operation a 200-kilowatt alternator, built by the Stanley Electrical Manufacturing Company, of Pittsfield, Mass., a Sorge-Cochrane feed-water heater and purifier and two Duplex steam-driven boiler feed pumps with a capacity of 100 gallons per minute against a boiler pressure of 150 pounds to the square inch, furnished by the National Steam Pump Company, of Upper Sandusky, Ohio; all these machines were entered as exhibits in the machinery department. Two Morrin-Climax water-tube boilers with a combined rating of about 700 horse-power, supplied by the Clonbrock Steam Boiler Company, of Buffalo, N. Y., are now being installed.

The Standard Paint Company Gives a House Warming to Its Employes.

The Standard Paint Company, of South Bound Brook, N. J., gave a house warming to its employés in celebration of the opening of an extensive addition to its factory plant, on the evening of Wednesday, April 22.

The company was organized in 1886 and took over a small building which had been occupied as a planing mill. From this modest beginning the company has developed, until now about seventy-five per cent of the ten acres of land which the company owns on both sides of the Delaware and Raritan Canal have been built upon.

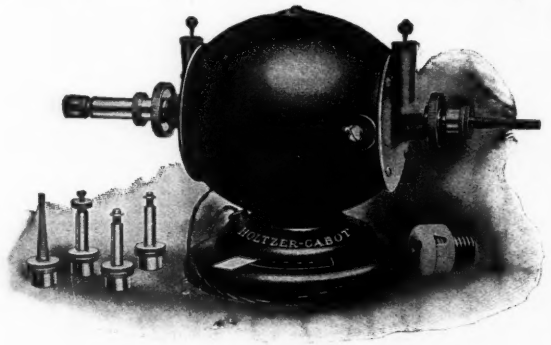
The new building which the company has just completed is 182 feet long and seventy-five feet wide. This is a two and three-story building, the main bay being two stories with a three-story L. The building is of substantial mill construction, the walls being of heavy brick masonry, and the roof of slow-burning material. This new building will not mean the manufacture of any new product, but it is necessary to accommodate the increasing demand for the specialties which the company now manufactures. The company is one of the pioneers in the manufacture of insulating compounds and paint preparations. The three specialties which the company now manufactures are liquid insulating compounds, water-proof insulating paper, and water-proof and weather-proof insulating "Ruberoid" roofing.

The works of the company are driven entirely by electric motors, the company having a small plant which generates all of the current necessary for the lighting and power used in all of the factories. In the boiler room there are two Babcock and one Root boiler, and in the engine room an American Ball generator is direct driven by an American duplex engine, built by the American Engine Company, of Bound Brook, N. J., giving 240 volts and 340 amperes. As an emergency apparatus there is a Western Electric Company generator, belt-connected to a small engine, this being capable of giving 220 volts and 180 amperes.

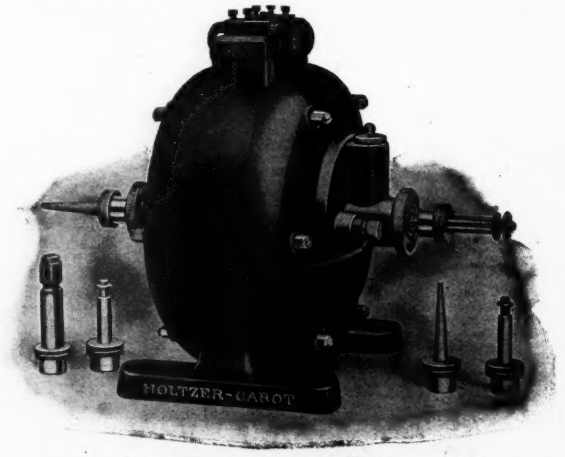
The location of the Standard Paint Company's factories gives it excellent facilities for the prompt reception of raw material and also for the prompt shipment of the finished product. The company has docking room which extends 400 feet on either side of the canal. This feature has been of great practical benefit in the development of the company's works.

The present officers of the company are Mr. Ralph L. Shainwald, president, Mr. Max Drey, vice-president, and Mr. Felix Jellenik, secretary and treasurer. Mr. L. C. Rugens has been superintendent of the works for fourteen years.

The new building was tastefully decorated by the hands employed in the factories, and about 300 of the employés and their guests were in attendance; a good orchestra furnished music for the dancing and a collation was furnished by the company during the evening. A large sixteen-horse-power electric vehicle, owned by the company, conveyed the New York and Philadelphia visitors from the station to the works. A number of persons prominent in the electrical field were present, and these were graciously received and heartily welcomed by Mr. J. N. Richards, general sales agent and manager of the New York office; Mr. F. F. Vandewater, purchasing agent of the company; Mr. Alfred F. Georgi, cashier, and Mr. Paul M. Wade, advertising manager, and the officers above named.



SMALL DIRECT-CURRENT MOTOR.



SMALL DIRECT-CURRENT MOTOR.

Small Direct-Current Power Motors.

While there is on every hand apparent evidence of the growing popularity of the motor drive, it is only within recent years that the manufacturer of electrical apparatus has made any special effort to produce motors of extremely small capacities. In such small units, motors have been confounded with the idea of being used as a toy, rather than as a piece of commercial apparatus. The adaptability of small motors, however, has been largely enhanced by the increasing refinements of mechanical design in small apparatus, such as dentists, physicians or special artisans may require. With the view of placing on the market a line of small motors which would prove available for these special uses, the Holtzer-Cabot Electric Company, Brookline (Boston), Mass., has designed the motors shown in the accompanying illustrations.

These motors range in size from one-tenth to one-fifth of a horsepower. The approximate speeds range from 1,200 to 2,200 revolutions per minute. The accompanying illustrations give a good idea of the lines and construction of these little machines. Owing to their small size, they may, in most cases, be operated without starting devices, and are therefore found particularly adaptable to small automatic machines and signaling apparatus which has to be started from a distance.

The field ring is of special soft steel, and the poles are provided, even in the smallest size, with a shoe which aids in holding on the field coils and assists in commutation. The shafts are of crucible steel, ground carefully to gauge, and the bearings are of hard-drawn prosphor-bronze. The commutators are of pure copper, insulated with mica, and the armature cores are laminated and drum wound. Grease-cup lubrication is used on all the smaller sizes, the grease being carried down the shaft by means of a pin, affording a very successful oiling arrangement.

Particular attention is called to the box brush-holder. This construction has proven, for small machines, the best which this company has used. The feed of the brush is parallel and the latch which presses the brush on to the commutator is prevented from striking the commutator as the brush wears away by a small point projecting from the body of the brush-holder. This is a valuable feature in a motor which must run for a considerable length of time with no attention. These machines may be supplied either in the semi-enclosed or completely enclosed form. In the latter case a housing which fits neatly over the commutator protects the inner parts from dust, moisture or mechanical injury.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MORE CAPITAL FOR BIRMINGHAM LIGHT COMPANY—At a meeting of the stockholders of the Birmingham Railway, Light and Power Company it was unanimously resolved to increase the capital stock by $1,000,000, this stock to be added to the preferred stock, making it $2,500,000. The common stock remains $3,500,000. The increase will be made at once. The object of the increase is for the benefit of extensive improvements under way and proposed.

ELECTRIC ENTERPRISE IN MEXICO—The Compania de Ferrocarriles del Distuto Federal—the Mexico Electric Tramways Company, Limited—which operates the extensive electric traction system in the city of Mexico, and its immediate vicinity, is about to construct a line between Lorento and Buenavista—two suburbs of the Mexican capital. The Rey del Oro Mining Company, which operated extensive mines in the state of Sonora, Mexico, proposes to construct an electric railway, over 200 miles long, to run from its properties to the Southern Pacific Railroad. Power will be derived from a waterfall located in the immediate vicinity of the east terminus.

WOULD FURNISH MACON, GA., WITH ELECTRIC POWER—A corporation is under organization in Milledgeville which is endeavoring to put 10,000 horse-power into Macon from the Milledgeville plant. The new company is known as the Milledgeville Electric Company, and will harness the water power at Furman Shoals on the Oconee River. A dam will be built at the falls which is to be thirty feet high. The falls are twenty-five feet. The new company bought out the old Milledgeville Telephone Company. Hon. Julius Horne has resigned the mayoralty of Milledgeville, as he is interested in the new company. Mr. J. N. Talley and Mr. Henry Horne, of Macon, are interested in the new enterprise.

TO AUTHORIZE CHICAGO TO OWN STREET RAILWAYS—The Chicago House Committee on Municipal Corporations has agreed upon a bill authorizing every city in the state to own, construct, purchase, mortgage and lease street railways. It provides for leasing not longer than twenty years to any company incorporated under the general corporation act of Illinois, but no city can do anything toward the construction of a railway without the sanction of a three-fifths vote of the electors. Bonds can be issued, or in lieu of them certificates of indebtedness, but not unless authorized by a majority vote of the people. Fundamentally the bill is intended to permit the city of Chicago to own the present system of street railways.

RAILWAYS IN NEW MEXICO—The Roswell Transit Company has been incorporated in Santa Fe, to build an electric railway, a lighting plant and to construct a waterworks system. The capital stock is $100,000. The Alamogordo Street Railway Company also has been organized with the following stockholders and who also compose the board of directors: Arthur P. Jordon, William Hodge, Samuel E. Pelphrey, Benjamin Sherrod, Thaddeus H. Clayford, Robert H. Price, all of Alamogordo, and Frank Avis, of Phœnix, Ariz., the capital stock is $50,000. The company is to build and operate a street railway and an electric light system. It may buy, sell and deal in houses, structures, lots, lands, orchards and parks, as well as develop water rights and deal in notes.

POWER PLANT ON NORTH COW CREEK, REDDING, CAL.—Work has been commenced on the new power plant of the Northern California Power Company on North Cow Creek in this county. It will be capable of generating 40,000 volts. The company already has a plant at Shingletown in this county which generates 20,000 volts and which is now furnishing power and light to Redding, Red Bluff, Corning, Willows, Keswick, De La Mar and other towns in Tehama, Shasta and Glenn counties. The new Cow Creek plant will be double the capacity of the one now in service, and will make the Northern California one of the very largest power companies in the state. The new power station will be completed before the close of the year, and the company will at that time widen its fields of operation, reaching still farther down the Sacramento Valley to find customers.

GREAT FALLS POWER—The preliminary arrangements for the future development of the Great (Caney) Fork Falls power plant at Rock Island, twelve miles northeast of McMinnville, are being made as rapidly as possible. The dam across Caney Fork River will be about forty-five feet high and three-quarters of a mile long on top. It will be built of stone cut from the bluffs on either side of the river. The company has bought up most of the land that the water will cover and will buy it all before the dam is completed. All the timber that will be covered by the water will be cut and sawed into lumber for the use of the plant. The water will be backed up and around into the bend of Collins River, and will be siphoned across the bluff at the narrows below the falls, making a direct fall of eighty-three feet on the wheels. It has been estimated that it will take eighteen months or two years to complete the work, and will require 500 or 600 stone and brick masons. This plant will cost something like $2,000,000 and will give employment to 3,000 or 4,000 workmen. This will be the largest power plant in the South.

A NEW KENTUCKY INTERURBAN LINE—Plans have been set on foot by the boards of directors of the Nashville & Columbia and Nashville & Gallatin Interurban Electric Railways for the expenditure of $3,000,000 in Middle Tennessee during the next year. Every share of stock of both companies was represented at the meeting, and a board of directors was elected by each company. The two boards are identical, and will be continued as the board of the Tennessee Interurban Electric Railway, when the consolidation is made. The companies now have a nominal capital of $50,000 each, and it is the purpose of the companies under the consolidation to increase that amount to $3,000,000. The consolidation will be effected as soon as practicable. The directorate which was elected is as follows: J. P. Greener, J. H. McMillin, R. P. Webb, Hillary House, J. F. Brownlow, Joseph Parks, of Franklin; D. K. Spillers, of Gallatin; Joseph P. Fulcher, W. J. Whitthorne, of Columbia; J. H. Connor, Frank Haskel and C. W. Ruth. In addition to the members of the directorate present, E. T. Chrisman, Frank P. Bond and Douglas Wikle attended the meeting. Of the directorate, J. P. Greener, R. P. Webb, Hillary House and J. F. Brownlow were not present at the meeting. They have recently acquired stock in the companies, and the transfer was ratified at the meeting.

MORE BAY POWER COMPANY LINES FOR BUTTE, MONT.—It has been announced in Oroville that before long there will be landed at the depot in Oroville 350 carloads of material for the construction of a power line from the Butte Creek line to French Creek. The point at which the lines will connect is presumably at Sundale, about four miles from Oroville; though two other lines of survey are being run, one from Wick's ranch, six miles from Oroville, and another from Pentz, six miles beyond. The first use to which this new line will be put is the transmission of current from the Butte Creek line for power and lighting purposes in the construction of a plant at French Creek. The second use will be the transmission of power generated at the last named place after the completion of the work of construction. Where the service of the Butte Creek power will probably be of greatest utility is with construction of a tunnel through the mountain from French Creek to Little North Fork. Undoubtedly much of the way will be through hard bedrock, and this will furnish a cheap and effective power for drilling by machine, as well as for other purposes. The object of the proposed tunnel is to tap Little North Fork and discharge it into French Creek, the waters of which latter would likely be insufficient during the dry season; for, it is said, the company was unable, or thought it not advisable, to build as large a reservoir as was at first intended. Its plan is, however, to build a large dam.

ELECTRIC RAILWAYS.

COLUMBIA, IND.—The city council has granted a fifty-year franchise to the Northern Traction Company, to operate an electric road.

CLEVELAND, OHIO—It is rumored that the controlling interest of the Springfield & Xenia Traction Company has been sold to agents representing the Bushnell syndicate, of Springfield.

NEW CARLISLE, IND.—The Chicago & Indiana Air Line Electric Railway Company has begun the construction of the road from South Bend to Michigan City, and the work will be pushed as rapidly as possible.

MADISON, WIS.—The Milwaukee & Southern Railway Company has filed articles of incorporation with the Secretary of State, its purpose being to operate a railway from Milwaukee to East St. Louis. The company is capitalized at $50,000.

JANESVILLE, WIS.—The Janesville Traction Company, composed of eastern capitalists, has been granted a franchise to construct a railway through Janesville, and from Janesville to Madison. The road will be built within a year, it is said.

PITTSBURG, PA.—The Wetzel & Tyler Railroad Company, of this city, has been incorporated with a capital of $250,000, to operate a traction line from New Martinsville to Sistersville. The incorporators are Thomas A. Watkins, John P. Gangwisch, Jr., Henry H. French, Robert Miller and George R. Wallace, all of Pittsburg.

EDWARDSVILLE, ILL.—The Cairo Electric and Traction Company has been organized with a capital of $150,000, and will take over the business of the two companies operating in Cairo at present. The new company will operate the street railway and furnish lighting. The railway will be extended and the lighting plant will be enlarged.

ALBANY, N. Y.—The state board of railroad commissioners has authorized the Buffalo, Dunkirk & Western Railroad Company to increase its capital from $305,000 to $3,500,000, and to issue first mortgage bonds of $3,500,000. The company proposes to construct and operate an electric railway system, connecting Westfield, Chautauqua County, with Buffalo.

ST. LOUIS, MO.—According to the present plans of the St. Louis Transit Company, a new power-house will be built in East St. Louis, and the power carried across the river by means of cables. This improvement is deemed necessary to furnish transportation for the large crowds expected during the World's Fair. The present horse-power furnished by the Transit company is 35,000; the new power-house will increase this to 75,000 horse-power daily.

OSKALOOSA, IOWA—The Iowa, Illinois & Wisconsin Interurban Railroad Company has been organized with a capital stock of $750,000. The company will build an electric line from Dubuque to Plattsville, Wis., a distance of thirty miles. The officers of the company are Peter Keine, Dubuque, president; S. B. Howard, New York, vice-president; C. H. Eighmey, Dubuque, treasurer; Charles Peaslee, Dubuque, secretary. Work will begin within a month.

HOOSICK FALLS, N. Y.—A charter has been granted by the Vermont Legislature for an electric railroad from Bennington, Vt., to the Massachusetts state line, at Williamstown, where a short extension of the Hoosac Valley Street Railway would connect the line with North Adams and Pittsfield. Terminals will be at Great Barrington, Mass., and Bennington, a distance of sixty miles, principally through the Berkshires. The company is capitalized at $150,000, and it is said that the road will be built this summer.

BRONSON, MICH.—It is now stated that the Toledo & Michigan electric road will be in operation within a year. The company was recently incorporated with $450,000 capital. With a few exceptions, it has a private right of way between Adrian and Coldwater, a distance of fifty-six miles. The road will parallel the Lake Shore Railway, and will carry freight as well as passengers. It will touch Cadmus, Clayton, Hudson, Pittsford, Osseo, Jonesville, Hillsdale and other points. The incorporators of the company are William P. Heston, S. C. Heston, W. W. Betz and P. P. Duket, of Toledo; J. W. Helme, Dr. C. H. Lards and R. W. Kirk.

ELECTRIC LIGHTING.

LITTLETON, COL.—A franchise for an electric light plant has been granted to Nelson Rhodes, Jr.

NORTH ADAMS, MICH.—North Adams has decided to bond for $3,000 for an electric light plant.

BARTOW, FLA.—The electric light plant has been acquired by the city, and $10,000 will be spent in improvements.

NEWROADS, LA.—W. H. Fleming, of New Orleans, has been granted the franchise for installing the electric and water plant.

MUSCATINE, IOWA—A fund is being raised here for the purpose of erecting an electric light plant. Local men are subscribing largely.

LAMBERTVILLE, N. J.—The common council has granted a one-year franchise to the Hunterdon Electric Company, for lighting the streets.

HARRISBURG, PA.—The Philadelphia & Reading Railroad will build and operate an electric light plant at Rutherford, to light the Rutherford yards.

WASHINGTON, PA.—The Washington Electric Heat and Power Company will build a large addition to its power-house. Work has already been begun.

HOBOKEN, N. J.—The big $400,000 power plant of the New Jersey Traction Company, in Newark, will shortly be completed. The completion will add a great deal to the transportation facilities of Jersey City, as well as Newark.

NEW DECATUR, ALA.—Cincinnati, New York and Boston capitalists have purchased the gas and electric plants, and will increase and improve them to the extent of $50,000.

WEST CHESTER, PA.—It is stated that the West Chester Street Railway Company will, within a year, erect a large power station at Lenape for the transmission of power to its lines.

MEMPHIS, MO.—J. P. Craig has sold the electric light plant here to a party of men which will incorporate under the name of the Memphis Electric Light Company, with a capital of $10,000.

ALLENTOWN, PA.—The St. Regis Light and Power Company has been incorporated with a capital of $50,000. The directors are: W. T. O'Neil, H. E. O'Neil and W. b. Babcock, of St. Regis Falls.

OBERLIN, OHIO—The Oberlin Light and Heating Company has been granted two franchises, both for a period of twenty-five years, one for a heating plant, and the other for a lighting plant.

SARATOGA SPRINGS, N. Y.—The Hudson Valley Railway Company is building an addition to its Queensbury power station. As soon as this plant is complete the company will generate 1,800 horse-power.

YAZOO CITY, MISS.—An agreement has been reached whereby the Yazoo Improvement Company has accepted the city's offer of about $30,000 for its system of sewerage, electric light and waterworks. The city will make many improvements.

BRANFORD, CT.—The Senate has passed a resolution authorizing the Branford Lighting and Water Company to increase its capital stock from $100,000 to $600,000. The corporation is also empowered to issue bonds to a maximum of $500,000.

BROCKTON, MASS.—The Old Colony Street Railway plans to greatly improve the power facilities in this vicinity. A large transforming station will be built to distribute power to the several lines of the system in and about Brockton.

HOT SPRINGS, S. DAK.—The board of trustees of the town of Custer has granted to R. M. Fuller and Fred Beardshear a ninety-nine-year franchise to erect and maintain an electric lighting, power and heating plant, telephone and telegraph system. Work must be completed within eighteen months.

STILLWATER, MINN.—Colonel W. G. Bronson has announced that an agreement has been made whereby the property of the Stillwater Gas and Electric Light Company and that of the Apple River Power Company will pass into the hands of the Western Gas and Investment Company. The new concern will spend about $50,000 in improving the local plant, and will also bring electric power to Stillwater from Apple River.

ELECTRICAL SECURITIES.

With the continued lack of animation which is characterizing speculative operations in Wall Street, the hope is becoming less definite each week that there will be a spring boom this year. While the quick recovery from the apprehension caused by the Northern Securities decision seemed to bid fair to a promising activity, the rally did not amount to anything which would bring it up to a normal condition. It is freely quoted that the Northern Securities decision and the money outlook have practically put an end to any stimulation of the stock market's activity through the formation of large combinations, and it is also stated that the decision, as rendered, has been responsible for the postponement of several important propositions.

The opening and occupation of the New York Stock Exchange in New York city was quite an important event of the week, and it was hoped that this would give a new impetus to trading in this financial centre.

The last bank statement is rather better than recently, and showed that the cash gains from the movement of money to New York were greater than at any time so far this spring.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 25.

New York:	*Closing*
Brooklyn Rapid Transit	65
Consolidated Gas	212¾
General Electric	193½
Kings County Electric	150
Manhattan Elevated	140⅞
Metropolitan Street Railway	129¾
New York & New Jersey Telephone	163
Westinghouse Manufacturing Company	210

A dividend of 1¾ per cent will be paid by the Westinghouse Electric and Manufacturing Company, on May 15, to stockholders of record at the close of business on April 30.

Boston:	*Closing.*
American Telephone and Telegraph	162½
Edison Electric Illuminating	275
Massachusetts Electric	88½
New England Telephone	135½
Western Telephone & Telegraph preferred	96½

Philadelphia:	*Closing.*
Electric Company of America	9 1/16
Electric Storage Battery common	74
Electric Storage Battery preferred	74
Philadelphia Electric	7¼
Union Traction	46¾
United Gas Improvement	107¾

Chicago:	*Closing.*
Chicago Telephone	147½
Chicago Edison Light	150
Metropolitan Elevated preferred	75
National Carbon common	24½
National Carbon preferred	96½
Union Traction common	6
Union Traction preferred	22½

TELEPHONE AND TELEGRAPH.

HUDSON, S. DAK.—A rural telephone company has been organized by a number of farmers in this vicinity.

FRANKFORT, KY.—The Bracken County Telephone Company, with $10,000 capital stock, has filed articles of incorporation.

RICHWOOD, WIS.—The Richwood Telephone Company has been formed by John Thaner, E. Krueg, H. Jouger and Frank Petri.

ELSBERRY, MO.—It is stated that a telephone exchange and an electric light plant are to be installed here within the next year.

HARVEY, N. DAK.—A company has been formed at Wimbledon for the purpose of putting in an electric plant and a county system of telephones.

WEST ALEXANDER, PA.—A concern known as the West Alexander Mutual Telephone Company has been organized by W. F. Moore and S. B. Chambers.

TOMAH, WIS.—The Ontario-Wilton Telephone Company has been organized with a capital stock of $5,000, and an exchange is to be installed in Wilton shortly.

MACON, MO.—The stockholders of the Nevada Telephone Company have elected Theodore Gary, president and manager; Dr. L. M. Thompson, vice-president, and W. T. Ballagh, secretary.

EMPORIA, VA.—A charter has been granted by the Circuit Court to the Weyers Cave Telephone Exchange, capital $5,000, owned by farmers of Augusta County. J. B. Kagey is president.

STROUDSBURG, PA.—At a meeting of the Monroe Telephone Company, held recently, the following directors were elected: J. S. Schoonover, E. F. Peters, C. B. Staples, W. A. Erdman and B. D. Hursh.

RICHMOND, MO.—The Stet, Rockingham & Norborne Telephone Company held its annual meeting at Stet recently, when it was voted to increase the capital stock of the company from $5,000 to $15,000.

CINCINNATI, OHIO—The Sunday Creek Valley Telephone Company, of Gloucester, has filed articles of incorporation, with a capital stock of $50,000. The incorporators are: G. E. Turner, A. F. Turner, G. W. Rose and A. B. Allen.

PERSONAL MENTION.

MR. K. C. RANDALL, electrical engineer with the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., was in New York city on Tuesday, April 26.

MR. FRANCK Z. MAGUIRE, of the Maguire Manufacturing Company, London, England, is making a visit to the United States, stopping in New York city during the past week.

MR. WALTER CARY, Milwaukee, Wis., vice-president of the Milwaukee Electric Company, is visiting East for a brief period, looking after the interests of the developing business of his company in this territory.

MR. R. R. GOVIN, of H. B. Hollins & Company, has been made president of the receivers organization of the Chicago Union Traction Company. Mr. James H. Eckles, former controller of the currency, has been elected treasurer, and clerk of the court Marshall P. Sampsell, secretary.

DR. W. M. HABIRSHAW, of the India Rubber and Gutta Percha Insulating Company, has recently completed a long trip through the West Indies and the southern states. Dr. Habirshaw has now returned to New York, and his holiday, it is announced, has been of great benefit to him.

DR. ADOLF FRANKE, the technical director of the Siemens & Halske Company, of Berlin, is making a visit to the United States, and will spend a few weeks in this country. Dr. Franke has put in service the longest Pupin telephone circuit which has been installed—450 miles—from Frankfort to Berlin.

MR. L. G. MARTIN, electrical engineer of the Okonite Company, has gone to Manila, P. I., to superintendent the laying of the cable and land lines supplied by his company for the new Pacific cable to that point. It is expected to have the cable in operation between Manila and Honolulu by July 4 of this year.

MR. A. A. THRESHER, Dayton, Ohio, was a New York visitor last week, assisting Mr. Smith, his eastern manager, in arranging for new and larger headquarters. Under Mr. Thresher's able and energetic management, the Thresher Electric Company has become one of the leading electrical manufacturing companies of the Middle States and is crowded with business.

MR. JAMES SWINBURNE has formally resigned the presidential chair of the British Institution of Electrical Engineers. He has done this in order that Mr. Robert Kaye Gray, who is very closely associated with telegraphic work, might be installed in sufficient time to allow of his organizing the entertainment of the members of the telegraph congress, which will be held in London in May and June next.

OBITUARY NOTICE.

MR. EDWARD TREMLETT CARTER, editor of the London *Electrician*, died at Clevedon (Somerset), England, on April 16. Mr. Carter was born at Calcutta, India, April 26, 1866. He was educated privately at Bristol, and at Merchant Venturer's College, and afterward at University College. In 1885 Mr. Carter was appointed lecturer at the school of Electrical Engineering, Hanover Square, London. He was a prolific writer on mechanics and engineering, and in 1893 he joined the editorial staff of the *Electrician*, and in 1897 he was appointed editor-in-chief. He was a member of the British Institution of Electrical Engineers, the Société des Ingenieurs Civils de France, and a Fellow of the Royal Astronomical Society, and of the Physical Society of London.

INDUSTRIAL ITEMS.

THE OHIO ELECTRIC COMPANY, Cleveland, is preparing to offer during the coming season, an improved fan motor, battery-power combination.

THE LYON METALLIC MANUFACTURING COMPANY has moved from 137 and 139 Fulton street, Chicago, Ill., to its new building at 18 and 20 South Ann street.

THE OSBORN-MORGAN COMPANY, Cleveland, is said to be busy to its full capacity in the manufacture of the "O.-M." types of arc lamps which it has this season put on the market.

THE UNITED STATES CARBON COMPANY, Cleveland, advises that it is building a large addition to its factory for the manufacture, on a larger scale, of electric light and battery carbons.

THE WILLARD STORAGE BATTERY COMPANY, 49 Ward street, Cleveland, has issued an interesting pamphlet descriptive of the Willard type of batteries as adopted for automobile service.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is distributing a new fan catalogue, listing a complete line of direct and alternating-current fans. This catalogue will be mailed promptly upon application.

THE FRANK PRESBREY COMPANY, advertising expert, announces its removal from Nos. 12 to 16 John street, to Nos. 3 to 7 West Twenty-ninth street, New York city. The new telephone number will be 1562 Madison Square.

THE ELECTRICAL MATERIAL COMPANY, Baltimore, Md., is the general sales representative for the Duncan Electrical Manufacturing Company. The Electrical Material Company will be pleased to furnish information with regard to the apparatus which it will handle.

A. D. GRANGER COMPANY, New York and Philadelphia, manufacturer of the "Star" safety tube boilers, has just issued bulletin No. 2. This describes and illustrates the "Star" safety water-tube boilers for power, steam heating and hot water heating. This bulletin will be sent to interested parties on request.

THE CLIFTON MANUFACTURING COMPANY, 308 West street, New York city, carries a large stock of fireproof insulating compound and insulating tape. Mr. H. C. Adams, Jr., has been appointed general sales agent, at the above headquarters. The Clifton Manufacturing Company has offices also in Boston and Chicago.

THE PROMETHEUS ELECTRIC COMPANY will move its offices to handsome quarters at 39 Cortlandt street, and the factory will move into larger quarters at 81 Dey street, during the early part of the month. In the new quarters the company will have better facilities for turning out its line of heating and cooking apparatus, for which there is an increasing demand.

THE FLEMING SLATE COMPANY has erected a large mill for the manufacture of slate products at its quarries at Poultney, Vt. The company has installed a complete outfit for making every variety of slate manufactured, and for marbleizing and other special finishes. The capacity at present is about 50,000 feet per day, but this, it is expected, will be greatly increased during the fall.

THE BARNUM & BAILEY CIRCUS has recently arranged for seventy Nernst lamps, ranging in size from the one-glower to the six-glower type, for the purpose of illuminating the large canvas pavilions. To furnish current for operating the Nernst lamps, Barnum & Bailey has purchased special engines to generate power. The circus will also use Nernst lamps exclusively for display advertising.

THE ALLIS-CHALMERS COMPANY, Home Insurance Building, Chicago, Ill., states that the volume of business on the books of the company to-day far exceeds that of any time since its organization, notwithstanding the fact that the output of the plant has been increased to a large extent. At the last meeting of the board of directors in New York, April 15, the regular quarterly dividend of one and three-quarters per cent was declared on the preferred stock.

THE UNITED STATES PULLEY COVERING COMPANY, 212 Washington street, New York city, is the manufacturer and sole owner of "Solvonon." This is a preparation which is used for covering both metal and wooden pulleys, and it is claimed will prevent the slipping of belts, and at the same time remove from them surplus oil. This material is sold in any quantity at a nominal price per square foot. The company will be pleased to supply illustrated literature on request.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., has begun the erection of a second factory in Rochester, which will be engaged in the manufacture of telephones. The plans call for a factory having 200,000 feet of floor space and capable of turning out 2,000 telephones per day. The company reports having secured contracts from the following companies: The Home Telephone Company, Kansas City, Mo., for 6,500 central energy telephones; Troy, Mo.; Orrick, Mo.; Gillman City, Mo.; Crestline, Ohio; Harrisonville, Ohio, and Summerfield, Ohio.

THE GOUDEY-McLEAN COMPANY, engineer, announces that from May 1, 1903, its offices will be located at 120 Liberty street, New York city. With increased capital and facilities, the company will continue to operate as the foreign department of American manufacturers syndicating the export interests of many well-known firms. The company will also act as agent for the distribution and sale of electrical apparatus and material in both the export and domestic branches. The officers for the ensuing year will be: Robert McLean, president; Edward E. Goudey, vice-president and general manager; Laurence W. Miller, secretary; William D. Vanderbilt, treasurer.

THE ELECTRIC CONTRACT COMPANY has opened headquarters in its new building, Nos. 202 and 204 Centre street, New York city. With greatly increased facilities, the company will be able to promptly handle orders of any magnitude. One of the specialties which this company has recently secured the agency for is the Williams sparking apparatus. Other popular apparatus which this company handles are pocket flashlights, electric time clocks, annunciator apparatus, and many other electrical accessories. Mr. Collin Armstrong is the president, and Mr. August H. Vanderpoel is the treasurer of the company. Mr. C. P. Skinner is the sales manager.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., manufacturer of the exide battery for electric vehicles, has recently placed on the market a new battery for sparking purposes. The great increase in the use of gasoline vehicles has convinced the company that a reliable sparking battery, which will furnish a "fat and hot" spark, will be greatly appreciated. The company has placed on the market a number of sizes, which are found fully described in a pamphlet recently issued by the company, giving capacities, weights and dimensions of the different types. A copy of this will be forwarded upon application to the Electric Storage Battery Company at any of its sales offices.

WESTINGHOUSE, CHURCH, KERR & COMPANY, New York, will install a 330-horse-power Westinghouse compound engine for generator driving at the plant of the Electrical Supply Company, Lima, Peru. Two 100-horse-power generating outfits have also been supplied to the Negociacion Minera de Promontorio Durango, Mexico, and to S. Pearson & Son, Limited, Salina Cruz, Mexico. The Mexican National Iron and Steel Company, also located at Durango, Mexico, will install a forty-five-horse-power compound engine for general power work, and a 150-horse-power Westinghouse compound engine-type outfit will be installed by the Michaelis Hallenstein & Company, Victoria, Australia, for lighting and power work.

THE CONTINUOUS RAIL JOINT COMPANY OF AMERICA, represented by Messrs. George G. Frelinghausen and Frederick T. Feary, has concluded the purchase of about twenty acres of land at Troy, N. Y., with the rolling mills, machine shops, and numerous other buildings formerly owned by the Troy Steel Company, part of which it has been operating under lease for the past three years. The property has a dock frontage on the Hudson River, and the New York Central Railroad runs through it. A new switch has just been completed from the New York Central Company's tracks around the rolling mill. The plant will hereafter be known as the Albany Iron and Steel Works Department of the Continuous Rail Joint Company of America. The output of the products of the company will be greatly increased. The general offices will remain in Newark, N. J.